TOWARDS A USER-ORIENTED APPROACH IN THE DESIGN AND PLANNING OF PUBLIC TRANSPORT INTERCHANGES

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DECLARATION

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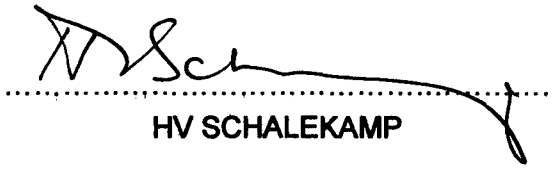

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ABSTRACT

Public transport provision in South Africa is set to change dramatically in the coming years if the plans and strategies of Government come to fruition. Policy clearly states that the needs of the end user of public transport services and facilities have to be prioritised, and that transport systems will be overhauled to provide a range of integrated trunk and feeder services, in emulation of the successes achieved in the so-called public transport 'model cities' of South America. However, it is not certain whether the range of public and private institutions involved in the planning, implementation and operations of public transport at the local level are ready to respond effectively to the policy requirements. Institutional fragmentation is the order of the day, public transport services are largely peak-time, commuter based services, and the minibus taxi industry remains effectively unregulated. The experience of public transport users, if measured by the efficiency of transferring between services at public transport interchange facilities, is of a very poor quality, and the design and planning guidelines for these facilities do not offer much insight into how this situation can be rectified.

This dissertation provides two insights in view of the current challenging public transport reality. Firstly, it investigates the link between institutional integration, and whether such integration has an effect on the experience of public transport users at interchanges. Secondly, it critically analyses the existing design and planning guidelines for public transport interchanges to explain why these documents do not seem to lead to improved physical integration between transport services, and ultimately an improved experience for the person wishing to transfer between those services. These links are tested by developing a framework that assesses the obstacles that reduce the efficiency of user transfers between services at interchanges, and it applies this framework at interchange sites in Cape Town in South Africa, and Curitiba and Sao Paulo in Brazil. The findings, when compared between sites and cities, lead to the formulation of recommendations regarding the expectations surrounding institutional integration and the provision of more effective design and planning guidelines for public transport facilities.

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SUMMARY

This research project was inspired by the interest that has been shown by South African transport practitioners and authorities in the so-called 'model' transport cities in South America. It is commonly accepted that these cities have managed to create relatively successful public transport solutions in their particular contexts. The apparent success of the public transport systems in South American cities is in part attributed to the presence of unified local transport provision authorities, the introduction of some or all of the features of bus rapid transit (BRT) systems, and the structuring of public transport services along integrated trunk and feeder routes. South African transport policy has taken this to heart. Public transport policy documents, at all levels of government, indicate that it is the intention to replicate elements of the South American model in our cities in the hope of improving generally poor public transport services.

However, in a review of policy, a number of questions remain unanswered with regard to the actual success of the South American experience: Has institutional integration indeed led to improved integration between different public transport services? Since the integration of public transport services depend on successful transfer facilities, then what is the nature of transfer facilities between these trunk and feeder public transport services? Finally, and probably most critically, what is the actual experience of the users of those public transport systems? To address these concerns, this research project established a structured framework to analyse one of the elements of such systems, public transport interchanges, in the Brazilian cities of Curitiba and Sao Paulo. The assessment tested the links between integrated institutional structures, more efficient transport facilities and improved user experiences. Assessments were also undertaken at interchanges in Cape Town, using the same framework, to enable a comparative analysis to be made and to identify in which manner, if any, the design and planning practices at the foreign interchanges could be applied locally to improve the process of transfer between different transport services.

Another problem was identified in the provision of effective interchange facilities, but this time applied primarily to the local context. Based on observations at public transport interchanges in Cape Town prior to this research project, it appeared as if those facilities were designed around the needs of the vehicles that utilised those facilities, and not the needs of the actual people utilising interchanges, resulting ultimately in a compromised experience for these people. Public transport policy indicated that the needs of the user should be prioritised, but this did not appear to be happening on the ground, even at newly constructed interchange facilities. Did the design and planning guidelines that directed the provision of such public transport facilities not prioritise the needs of the user? To investigate this problem, this study critically analysed the existing guideline documents

to establish what role they played in facilitating effective transfer between transport services, and how they resolved the relationship between vehicles and people that is inherent in the nature of interchange facilities. The aim of this particular investigation was to provide recommendations on how design guidelines for public transport facilities and interchanges could be improved to better accommodate the needs of the users and also to better respond to changes in service provision in relation to the planned trunk and feeder transport systems.

The problems outlined above, and the aims of the research, are outlined in Chapter 1 of this document. In order to provide data that could support the recommendations of this dissertation, three research strategies were developed to structure the activities undertaken in this study. These strategies were a literature review of existing policy and facility design guideline documents, the development of an assessment framework to analyse the user transfer experience at interchanges, and case studies of existing facilities at three interchanges in each of the identified cities (Cape Town, Curitiba and Sao Paulo), analysed according to this assessment framework. The research method, presented in Chapter 2, was developed around three central research questions, and these, along with the findings that responded to the research questions, are outlined below.

What direction does the regulatory and planning environment give to the design and planning of public transport interchanges?

Interchanges are public facilities. As such, the provision of existing interchanges would have been guided by public policy and guidelines. What direction did policy provide in terms of a specific role for interchanges in the public transport system and what was the focus of guidelines that transferred this role into practice? This question is addressed in Chapter 3 through a review of public policy and a number of guidelines that were concerned with the provision of public transport systems and public transport facilities.

In terms of policy, it was clear that transfers between services (particularly trunk and feeder services) were to be encouraged to promote efficiency in the system. This meant that interchanges played a central role in urban public transport systems. However, it was recognised that public transport systems and facilities were predominantly vehicle-oriented, and that the user should be prioritised in order to redress this imbalance.

Thus the focus of the review turned to the most recent guidelines for the planning and design of interchanges to see how the user would be prioritised, and to investigate the measures contributing towards making user transfers more efficient and convenient. However, it emerged that even the guidelines produced in the last five years were modally oriented. One reason for this was that the main contents of these guidelines were carried over without noticeable modifications from mode-specific guidelines developed in the 1980s. Very little guidance was given on how to manage and improve the user transfer

experience between modes. If anything, the suggested vehicular layouts actually reinforced conflict between vehicles and users by necessitating users to cross the travel paths of vehicles. The guidelines clearly contradicted policy goals. Since the guidelines did not provide adequate guidance on the needs of users during transfers, the second research question was put forward:

What is interchange when observed from the point of view of the user?

In order to develop an in-depth understanding of user transfers, it was necessary to first identify the elements that affect the user experience during interchange. These elements, described in Chapter 4, were the characteristics of the types of users that utilise interchanges, the various functional components of interchanges, the transfer trip tasks, and the obstacles that all types of users encounter while moving over and between each of these components.

When transferring, a user would disembark from a vehicle in a trunk or feeder public transport service onto that vehicle's platform, and then connect to another feeder or trunk service's platform from where the vehicle that goes to the onward destination could be boarded. The connecting area was described as a concourse – the link between different services' platforms. The transfer itself resembled a trip from one vehicle to another along which the user had to perform certain tasks, such as passing through access control and confirming whether he or she was at the correct platform. During this trip there could be various obstacles, such as the lack of a signboard showing where the next service departs from, or a gathering of vendors blocking the way to the exit. The former type of obstacle was termed a wayfinding obstacle, and the latter an accessibility obstacle. The abilities of all users, be that physical, sensory, cognitive or financial, influenced the degree to which these obstacles affected them when performing a transfer.

Once an analytical framework, or data collection tool, describing the elements of the user transfer experience was developed, it was possible to collect data according to this framework at actual interchanges in order to gauge the user's experience during transfer in reality. The data collection tool can be found at the end of Chapter 4.

What lessons for improving interchange design and planning in Cape Town can be learnt from comparable interchanges in other cities?

The last question was answered by applying the data collection tool at interchange sites not only in Cape Town, but also in Sao Paulo and Curitiba, in order to compare the findings across sites and cities to see whether foreign interchange practice could benefit Cape Town. Brazil, like South Africa, is a rapidly developing country presenting similar socioeconomic attributes and challenges, but with a much stronger public transport culture. The particular cities were selected because Sao Paulo had a similar modal mix to Cape Town and service extensions or modifications often had to be retrofitted into a

complex existing urban fabric. Curitiba's transport system was in large part what the desired future system for Cape Town was based on, and it had a similar population size. The comparative findings, revealed in Chapter 5, brought to the fore a number of results that responded to the research aims. The recommendations of this study, as elaborated in chapter 6, are based on those results.

The first recommendation in view of the findings of this study is that the establishment of an overarching transport authority in isolation of changed design practices will not result in improved service to the user. This is not to say that this step should not be taken: institutional integration provides the general background against which more integrated public transport services, and consequently more space-efficient and integrated interchanges, can be planned. However, one prerequisite for more effective user transfers appears to lie in the design of the interfaces between, and the physical and wayfinding characteristics of, the components of interchanges.

Based on the findings of this dissertation, the second recommendation is that it is critical that guidelines for rail services are incorporated in the same documents as those for road-based services in order to streamline transfers between all services in equal measure. Effective integration cannot take place if different services are guided by their own sets of rules. Clearly, it is necessary to have at least some level of institutional integration to achieve this, as illustrated in the findings and captured in the previous recommendation.

The last recommendation with respect to the findings is that planning and design guidelines for public transport interchanges should be reviewed and adjusted to prioritise and reflect the full range of user needs, in addition to effectively providing for the needs of public transport services. To aid such a change in focus, this dissertation has developed a structured assessment framework for analysing the obstacles to effective user transfer at interchanges. On the one hand, this framework can be applied in retrospect to interchange facilities that already exist and operate, as was done in this study, to test the quality of user transfers at such facilities and provide insight into what obstacles should or could be removed to improve the transfer experience. In view of the findings of this dissertation, the attributes of user transfers that could be improved, without altering the physical layout of an existing interchange facility, are comprehensive wayfinding provision, integrated fare collection systems and accessible boarding features on vehicles. On the other hand, the planned trunk and feeder networks in South African cities would likely lead to the construction of new public transport facilities, or the expansion of existing facilities to include new services and vehicles. If these guidelines continue to be based on the needs of the existing vehicle fleets and their standard dimensions, as is the case at present, they will not be able to effectively accommodate vehicles with other access characteristics, such as at-grade boarding or multiple doorways, or dimensions, such as articulated or wide-body vehicles. Guidelines need to be more flexible, and it seems as if

a focus on the user, and not the vehicle, would address this need and liberate guidelines from their currently limited vehicular scope. To this end, the central argument of this dissertation does not only motivate why there is a need for a fundamental shift in the interchange design and planning mindset in order to address the poor quality of the user transfer experience, but also describes why the mindset shift must be accompanied by a comprehensive revision of existing interchange design and planning guidelines.

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1. INTRODUCTION

1.1 MOTIVATION FOR THE RESEARCH

The concept and reality of urban public transport, no matter the setting, are fascinating, if exceedingly complex. From its physical character, which mixes vehicles, roads, sidewalks, people, to its inner workings of bureaucratic regulation, urban development and statistical method, the nature of public transport provision lends itself more to experimentation than to once-off solutions. Specialists might be aware of the characteristics of the individual parts of public transport systems, backed up by knowledge accumulated over time and from various geographical locations. However, putting all these elements together in what is said to be the right proportions does not necessarily mean that you will end up with an efficient system. It involves tweaking of each component to just the right level, and even then you are not guaranteed success. But such is the nature of public transport systems. Surveys and statistical methods provide input on where people want to go, planning provides over-arching guidance on how such movements can be accommodated, technology provides solutions in accordance with the magnitude of movement, and the physical environment is shaped to provide for this movement. Yet there is no universal response to all these facets. Each scenario requires its own solution, and even then, a truly effective system might still remain out of reach. There is no instant formula that results in a good quality public transport system.

Against this background, this dissertation focuses on one aspect of the public transport system: the interchange, i.e. the place or facility where a public transport user can transfer from one mode of transport to another (GPG-DPTRW: 6). My motivation for embarking on this research project emerged from personal observations in Cape Town and elsewhere. The first observation was that public transport services in Cape Town were of a much poorer quality not only in comparison with first world cities, but, more critically, also when compared to cities in a similar developing world context. The second observation, linked to the first, was that it appeared as if the design of public transport interchanges in Cape Town did not adequately attend to the needs of the actual people who utilised such facilities. This exacerbated the perception of poor quality. The last observation was that, even though South African government policies that direct public transport provision, which I had come into contact with through other projects, had for a number of years been proclaiming that the passenger should be prioritised, the reality clearly was to the contrary.

The South African transport industry, which includes the regulatory, academic and private spheres of interest, have been attempting to address the challenges of providing urban public transport, such as those detailed above, through the development of strategies and planning models that have drawn on the experiences and realities of cities around the world. In particular, the developing world 'model transport cities' of South America, i.e.

Curitiba in Brazil and Bogota, capital of Columbia, have been the subjects of numerous official and unofficial expeditions and interactions that have aimed to understand why and how those cities have managed to get their public transport systems operating effectively, and even make them pleasant to use (e.g. MLH 1995). The Southern African Transport Conference, as barometer of the local transport industry, has seen publications presented that make reference to experiences and observations from these cities, and how their ideas could potentially be implemented locally (Pienaar et al 2005; Willumsen & Lillo 2005). Having visited Brazil previously, as a tourist, but with the intention of academic interaction, and having attended two sessions of the SATC, I was intrigued by the possibilities of what might be achieved by extracting lessons from the research of others into public transport provision in other locations. Brazil's public transport is simply better than ours – as a tourist I never had the need for a private car, inter- or intra-city, even in non-'model' cities. However, being able to speak the local language (Portuguese) was a non-negotiable requirement in order to experience such mobility. I was inspired by the glimmer of hope that these places offer to our strained public transport reality, but bore some concerns about the efficacy and methodologies of fact-finding missions. I was sceptical about the depth of investigation into the actual day-to-day public transport operations encountered, and as a consequence also about the actual applicability in the local context of the ideas that were put forward as ideal for local conditions.

Nonetheless, I saw an opportunity to gain a greater understanding in my own field of research, that of the design and planning of public transport boarding and transfer facilities in Cape Town, by following a similar line of argument as that of those who have engaged in study travel. Public transport transfer facilities are often the 'front door' of the public transport system: you get into the train from the station's platform, step onto the minibus at the rank, or get into the bus from the bus terminal or shelter. As such they are as integral a part of public transport as the actual vehicles themselves, and exist the world over to be studied and compared. Since there is such an interest into what is, and has been, happening in the South American model cities, I considered the possibility that I could apply a similar process in my research, but at the same time address the concerns I had about previous methods and their validity. It was important to set some type of datum, or identify peerage, so to speak, against which to evaluate the performance of local interchanges, but also, given the local policy direction towards transport and development corridors, to gain a potential glimpse into the future – Brazilian public transport practice adopted corridor planning to some extent quite a number of years ago. Besides being the primary access point into the public transport system, interchanges also play a nodal role on the network of existing and planned corridors. The guaranteed high flows of pedestrians at interchanges offer significant commercial and social opportunities. How do the foreign counterparts harness such opportunities, if at all? I was under the impression that these less obvious functions of the interchange were, at least officially,

being ignored locally. Their structural, spatial and social importance appeared to be sidetracked to a large degree in favour of simply getting as many able-bodied commuters onto whichever public transport vehicle as present, as quickly as possible. Thus, a focused, critical, on-site investigation might change the incumbent mindset by providing actual examples of improvements that exist in a comparable environment – a catalogue of physically existent design practices.

Besides concerns about the physical attributes of interchanges, and commentaries from abroad, I was, and am, becoming more and more convinced that there is a fundamental and institutionalised weakness in the public transport interchange design and planning approach. Public transport interchanges embody a synthesis of architecture, engineering and urban planning, with intricate inter-relationships between these realms. Interchanges are spatial facilities that accommodate the movement of people into and out of the realm of public transport, guided by barriers and open spaces in various combinations. Concurrently to the arrival and departure of passengers, interchanges cater to the needs of vehicles that afford passengers the opportunity to embark and disembark, with technological principles and operational provisions guiding the flows of vehicles and people. The urban role of interchanges as places of social concentration and commercial opportunity bears a direct relationship to the flows of people generated by transport activity and the siting of interchanges along desire lines. Yet when looking at existing interchanges in Cape Town, it is hard not to notice the poor quality of such facilities and the relegation of the spatial, social and economic importance of such facilities to the incidental or the informal. A study at the Cape Technikon (now the Cape Peninsula University of Technology) that developed and tested comprehensive performance measures for interchanges beyond only traditional transport considerations confirmed this mismatch between theory and practice (Verster 2004). Furthermore, the reality of fragmented institutional structures appears to translate into the triplication not only of facilities (taxi *rank*, distinct from bus *terminus*, distinct from train *station*), but also of routes being traversed, fare collection systems and staff that need to be provided for each of these modes. Where does this leave the actual user, the passenger? With three separate services, and ultimately three separate systems. The inefficiency of such a situation is surprising in a budget-constrained context, but that is the current state of affairs. And nowhere is it better illustrated than at the interchange itself, where all these issues manifest.

The process of interchange inherently centres on the user: it is the person that commits the act of transfer. Thus, I believe that the entire process of designing and planning public transport interchanges should focus on the user as the basic design unit. With government policy adopting a more business-like, customer-driven slant, even if it might only be evident on paper at the moment, the practice of having transfer facilities designed around specific vehicles could quickly render such facilities obsolete if rationalisations in

service provision are carried out to conform to such new policy. Conversely, if interchanges are designed around the user, to the specifications that the user, and not any specific vehicle, requires, I believe such a process would unlock much more than just transport opportunities. The development of the spatial, social, urban and transport potential of the interchange, however, necessitates a multi-disciplinary team effort, and as such is a major challenge to the existing mindset. It requires professionals who can think beyond modal analysis, vehicle sizes and passenger counts. I believe that such a change is inevitable, if exceedingly difficult to bring about given the slow nature of change at the scale of the city. But I do not believe that it is a challenge that can be avoided. With this dissertation I wish to illustrate, in as simple terms as possible, the reasoning behind why I believe that a user-oriented approach to public transport interchanges is essential. The research process has endeavoured, as far as possible, to look at real-world evidence of interchanges through the eyes of a user to better understand how the current planning mindset is inhibiting us from achieving effective interchange in our public transport systems. Besides illustrating the problem, the dissertation critically considers and elaborates the findings of the research so that it can also contribute towards better design and planning of public transport interchanges – an argument for positive change.

1.2 AIMS OF THE RESEARCH

While it is a simple act to say that the design and planning of public transport systems, and by extension public transport interchanges, should centre on the needs of the public transport user, the practical and regulatory implications of such a statement are not necessarily clear cut or subject only to a single iteration. In order to formulate a coherent and practical strategy aimed at, ultimately, improving the experience of the end user of the public transport system it is critical to understand the framework that guides the planning and implementation of public transport and interchanges, the functioning of interchanges as a link in the public transport chain and the current reality that the user faces in negotiating such facilities. These three issues are rephrased into research questions that structure the dissertation, but also respectively provide the opportunity to develop tools that can help in constructing solutions to the issues that the investigation raises.

1. What direction does the regulatory and planning environment give to the design and planning of public transport interchanges?

Public policy provides direction to the quality and quantity of public transport provision. In other words, regulatory input, in the form of policies at the different levels of government, should aim to establish the mindset or framework within which development occurs. These frameworks operate at a number of scales. At the national level, transportation policy could, for instance, state that public transport should be promoted across the country over private car travel. Provincial policies might be concerned with competition for

resources, of which transport is one, between different settlements. Municipalities, or local governments, can govern how transportation develops within cities' boundaries, decide on the nature and extent of the local public transport system and develop guidelines for the different components of such systems.

Public transport interchanges are a local, urban phenomenon. However, regulation at all the levels of government play a role in the focus, planning and delivery of public transport networks, and thus also of interchanges as integral parts of such networks. By asking this question, the research aims to establish what regulatory documentation exists that provide input into the design and planning of interchanges, and to what extent it focuses, if at all, on the needs of the user as the primary concern. This inquiry will provide grounds against which to measure the translation of words into reality: how existing interchanges reflect the regulatory and planning environment that produces them.

2. *What is interchange when observed from the point of view of the user?*

There are two distinct meanings of the term interchange that apply to the research. The first is an abbreviated form of 'public transport interchange' or 'transport interchange', that is, the term that describes the physical facility or space that forms part of the transport system at which passengers transfer between transport services (GPG-DPTRW: 6). The second meaning is the action of transferring between services, or the process of interchange that occurs within the transport interchange. Thus, *interchange* is both facility and process at the same time.

The number of people who use public transport in Cape Town on a daily basis is substantial – that is over 1,13 million passengers on the trains, buses and minibuses that criss-cross the city (CCT 2006a: 50). A lot of those people utilise interchanges, in some form or another, to access the transportation network. Sheer numbers do not, however, imply that the chain of events that take place from the time that the actual built structure of the interchange is entered until the public transport vehicle is boarded is completed seamlessly or effortlessly. While the commuter may complete the same return trip five or six times a week without having to think about where to get on or off or buy a ticket, what about the tourist, or the person who cannot drive any more and is now forced to seek alternative means of transport? The conclusion has to be that there are many more needs to be satisfied by public transport services and facilities than just commuting.

In order to be able to analyse and improve interchange as a process, and interchanges as physical facilities, it is crucial to have a good understanding of who the users are that could potentially utilise such a facility. This trains the observer to look beyond the obvious needs of the predominant user to recognise obstacles that might affect the overall, inclusive user experience. What are the steps of performing interchange, or, in other words, what actually happens inside interchanges? How does an interchange cater for

these actions? What obstacles exist during this process that may exclude certain users from successfully completing interchange? Answers to these questions help to construct a mental model of what interchange is from the point of view of the user, and lays the groundwork for analysing actual interchange facilities in a user-oriented approach.

3. What lessons for improving interchange design and planning in Cape Town can be learnt from comparable interchanges in other cities?

Case studies provide a test bed for the application of hypothetical models. Fieldwork can take on even greater significance if it compares the findings in one location to the findings in another by using the same evaluative framework. The research analyses interchanges in Cape Town according to a model based on the needs of the user as the primary design consideration. Given the interest in the public transport systems in South American cities, the process of analysis is duplicated in two Brazilian cities at interchange sites that perform the same function and have the same structural importance as those in Cape Town. There are a number or reasons why this line of investigation could prove fruitful. Firstly, a comparative exercise can lead to a more comprehensive model for evaluation – issues that might not even be considered in one setting may be brought to light by looking in another. Secondly, problems and opportunities found in one location could already have been addressed more successfully in another location, avoiding having to 'reinvent the wheel' if such solutions prove to be transferable. Lastly, due to different regulatory environments, comparative observations may be made as to the impact of regulation on physical form, leading to potential insights into what change is required in the management and operations of public transport systems, and specifically interchanges, to effect an improved experience for the end user.

1.3 RESEARCH SCOPE AND LIMITATIONS

Describing the workings of public transport – this includes its operations, facilities and services – is in itself a large-scale and potentially cumbersome endeavour. There are an infinite number of permutations in which the parts of public transport systems can be combined to create a functioning whole in any particular setting, and an equal number of studies that can be undertaken to analyse or improve such a system and its parts. It is important to set out, in as clear terms as possible, the boundaries within which research is to be undertaken given the reality of public transport, but even then it might be impossible not to refer to components of the overall system. This seems to be the case when investigating public transport interchanges. Even though an interchange might appear to be a distinct entity, transport services, physical infrastructure, and even commerce and convenience facilities, can also congregate within the same space. The scope and limitations of this dissertation are outlined here, and take into account this reality, as well as the budget and capacity constraints that accompany an individual research project.

The definition of a public transport interchange, as used in this dissertation, is taken to be the place at which passenger transfer occurs in the public transport system, be it alighting from a bus to get onto an onward train, or cycling or walking to a point at which a minibus can be boarded. An interchange is not defined by any particular transport vehicle or by its physical size or nature, but by its function – as the place where transfer from one transport service to any number of other transport services can take place . This definition also recognises non-motorised transport and motorised transport as equally important facets of an urban transport system (GPG-DPTRW: 6).

The public transport interchange is a constructed, immobile facility. The field research undertaken in this study is confined to the functional boundaries of the interchange, that is, the parcel of land on which the interchange is located. Transport activities are only considered from the point where they enter such a site to where they exit the site. Various human activities might be arranged around the site, but these are only taken into consideration when they are located within or adjacent to the interchange and if such activities are predominantly related to the flows of users generated by the transport activities that take place on that site. An example of an inclusion would be a vendor selling refreshments next to the gate that affords access into the interchange, and an exclusion would be a convenience store located on the opposite side of the road to an interchange. The site boundaries will be represented visually, but are not necessarily clear-cut. Exceptions, if such exist, will be explained or motivated in the text.

The public transport interchange is a node in the public transport network. Due to the current regulatory emphasis on public transport corridors served by a high-volume public transport service ('trunk service'), with lower intensity transport services that feed into such a corridor network ('feeder services'), the node at the confluence of these two services is a critical junction in a public transport system (Bertolini & Dijst 2003: 32-34; Frieslaar et al 2005). The interchanges that are investigated in this project are located at such nodes, whether they are part of an existing, informal corridor, or existing within a planned future corridor. Transport services that serve such nodes are analysed primarily according to their trunk or feeder function, and not according to the type of mode or vehicle that carries out the service.

Interchange is also an action performed by users of the transport system. Because this action is defined by the user, and not the modes or vehicles between which interchange occurs, research activities in this study are accordingly conducted with the user's point of view as the basis of investigation. There are, however, notable limitations that this approach imposes with regards to behavioural patterns and information gathering. There is not a substantial amount of surveyed data available on transfers between public transport services at the local (municipal) level. The National Household Travel Survey (RSA-NDT 2003) has some information on transfers, but the very small sample in Cape

Town (3328 persons participated in the survey, of which 469 reported that they transferred during a work trip) does not offer any conclusive insights, while Cape Town's Current Public Transport Record contains no information on inter-modal activity (CCT 2005a). However, it is not possible for an individual to survey sufficient numbers of users at interchanges to reflect the actual user experience of such facilities, let alone other stakeholders such as traders, managers and regulatory officials. The unavailability of data and manpower is overcome through a thorough conceptualisation and investigation of interchange as facility and as process: applying knowledge of interchange usage and design from existing literature and making visual observations of users' experiences during interchange provide an understanding of the user's experience. This study does not, and cannot, exhaustively describe what the user's experience is, but rather motivates why a design approach that focuses on the user should be developed that would ultimately lead to user-oriented design and planning. Hence, the recommendations of this study are at a more general level.

The geographical context of this study was that of Cape Town. For comparative purposes, fieldwork was also done in Curitiba and Sao Paulo in Brazil. In each city the number of interchanges was limited to three. The process of investigation and the evaluative criteria were the same at these sites. Interchange sites were located directly on a public transport trunk service with a range of feeder services radiating from the site. Interviews, aimed at clarifying operations, planning and design processes at the documented interchanges, were only conducted with either on-site staff or staff from the marketing departments of the various agencies managing the transport services operating at the interchange sites visited. In terms of literature, theory which describes interchange design and planning was not limited to local sources, but the investigation into regulatory frameworks was limited to that of the various levels of the South African government that guide the provision of public transport services and facilities.

The objective of this study was not to formulate design guidelines that would replace or augment existing guideline documentation, or other regulatory or descriptive texts that affect interchange design. Rather, information gathered during the literature surveys and fieldwork was used as a background against which recommendations that aim to directly or indirectly improve the transfer experience of end users of interchanges could be formulated. Logical steps following on the research process would have been the application of such recommendations to future interchange design or refurbishment projects, the development of improved regulatory processes and design guidelines and ultimately the redesign of the entire interchange provision process. However, the time and capacity constraints of this study precluded such endeavours from being undertaken.

1.4 ORGANISATION OF THE DOCUMENT

The abstract, acknowledgements and summary of the contents of the dissertation can be found in the first pages of this document. The table of contents and the lists of figures and tables are presented thereafter. Then follows the main body of the document, consisting of the six chapters outlined below:

Chapter 1 offers an introduction into the research presented in this dissertation. In this chapter the motivation for the research, and the aims, scope and limitations of the research process are presented.

Chapter 2 outlines the method of the research process. It explains the procedure that was followed in identifying the research strategies, according to which the research was conducted.

Chapter 3 is a review of literature that is relevant to the background and argument of the research process. The research topic is closely linked to the existing body of knowledge surrounding the regulation and design of public transport systems and interchanges, and this chapter critically considers relevant texts, both in regulation and design, and their links to the research argument.

Chapter 4 presents the evaluation framework that arises from a conceptual understanding of the process of interchange, and the associated interchange facility, as seen from the point of view of the person performing interchange. It describes the types of users that utilise interchanges, the functional components of interchanges, the act of interchange and obstacles that users may encounter while performing interchange. The concepts developed in this chapter form the basis of the data collection instrument, which is included at the end of the chapter.

Chapter 5 contains the findings of the fieldwork, which investigated the functioning of selected interchanges in Cape Town, Curitiba and Sao Paulo. This chapter summarises the data that was gathered through the application of the data collection instrument – complete findings for all sites, as captured with the data collection instrument, are contained in the Appendix. This chapter concludes with a comparison between the findings in the different cities.

Chapter 6 draws together the research argument into recommendations and conclusions. It responds to the questions set out in the aims of the research, compares the findings in the literature to those of the fieldwork and suggests how differences in regulation and practice could be reconciled. It also outlines topics for further research that could not be undertaken as part of this project, but which would support and extend the central argument presented herein.

The list of terms commonly used in the document, the research references and the Appendix can be found at the end of the document. The Appendix contains the

completed data collection sheets and photographs for all the sites that were visited, and is presented in the form of a compact disc inside the back cover.

2. RESEARCH METHOD

2.1 INTRODUCTION

The purpose of this study was to determine the experience of users while transferring between public transport services or vehicles of the same service at public transport interchanges in Cape Town. The following three questions guided the research:

- *What direction does the regulatory and planning environment give to the design and planning of public transport interchanges?*
- *What is interchange when observed from the point of view of the user?*
- *What lessons for improving interchange design and planning in Cape Town can be learnt from comparable interchanges in other cities?*

In order to answer the research questions two research strategies were followed. The first strategy was a literature review; the second was empirical research in the form of case study investigations. This chapter contains a discussion of these strategies, thus answering the question: How was the research done?

2.2 LITERATURE REVIEW

A literature survey was undertaken to answer the first research question about the direction provided by the regulatory and planning institutions to the design and planning of interchanges. In order to respond to this question, information was required in two fields, namely public transport policy, and guidelines for the design and planning of public transport interchanges.

The first field of survey was thus existing policy guiding the provision of public transport systems and public transport interchanges at the different levels of government. Extensive internet and library searches were conducted to obtain such literature. A number of complete policy documents were identified and sourced through internet searches that led to the websites of national and local government departments concerned with transport. The most productive library search was in the archives of papers submitted to the Southern African Transport Conference (SATC). Some of these papers were produced by various South African departments of transport and others by transport practitioners, and were either direct presentations of policy documents, or contained references to policy documents. In cases where such indirect references existed, or where internet searches only resulted in the identification of the titles of policy documents but not the contents thereof, interviews with transport practitioners and academics permitted the sourcing of hard copies of a number of these documents.

The second field of survey was literature guiding the planning and design of public transport interchanges or facilities. Library searches identified literature that contained

information on the spatial and urban design qualities of public transport facilities and the role of public transport interchanges in transport systems. Internet and library searches and interviews with public officials provided the titles of guidelines for the design and planning of public transport facilities and interchanges that are in general use at present, and subsequent interviews with practitioners and academics provided access to hard copies.

Keywords that were used frequently in the literature survey included:

Transport policy, public transport policy, department of transport, transport white paper, interchange, public transport interchanges, public transport facilities, public transport transfer facilities, modal integration, and *design and planning guidelines for public transport facilities, interchanges, modal interchanges and transfer facilities.*

The results of the literature survey are presented in Chapter 3 of this dissertation.

2.3 EMPIRICAL RESEARCH: CASE STUDIES

A qualitative research strategy was selected since the purpose of the research was to obtain detailed and rich knowledge of a specific topic (Miller & Salkind 2002: 143). This purpose would not have been fulfilled by a quantitative strategy. In the case of this dissertation, the knowledge to be collected was required to allow for an in depth understanding of the experience of the range of users during all stages of the transfer process that takes place at a public transport interchange in different locations, therefore answering the second and third research question:

- *What is interchange when observed from the point of view of the user?*
- *What lessons for improving interchange design and planning in Cape Town can be learnt from comparable interchanges in other cities?*

To obtain the knowledge that was necessary to answer these questions, case studies were undertaken at a limited number of public transport interchange sites. A case is defined as a system bounded by time and place and may be a programme, an event, an activity or individuals (Miller & Salkind 2002: 163). In this study, the case was the event of user transfer between one service or vehicle and another that took place at public transport interchanges. The case study methodology was particularly suited to this investigation as it entailed the development of detailed, intensive knowledge about a small number of related cases in their particular contexts (Robson 2002: 89).

2.3.1 Site Selection

The sites to be studied were selected through purposive sampling, as opposed to random sampling. This was due to practical considerations – the researcher only had the capacity to document a limited number of study sites, but these sites were judged to be

representative of the user experience at interchanges in general (Miller & Salkind 2002: 53). In order to form a more comprehensive view of the experience of users at interchanges, the study proposed to compare the findings at sites in Cape Town to those in comparable cities elsewhere in the world.

Firstly the criteria for selecting particular interchanges were identified. This study developed from a need for effective interchange facilities at the nodes where trunk and feeder public transport services meet. In order to respond to this need, cases would be selected at such points of integration to highlight what problems are currently experienced. User volume was the other main informant in the selection process of individual interchanges. An interchange with a high volume of users might highlight a greater range of issues affecting the user experience than one with a low volume, and thus the results at the former would be more informative.

In terms of the selection of a particular country, Brazil was chosen, since the socioeconomic standing of that country was at the same level as that of South Africa. The planned transport networks for South African cities, incorporating trunk and feeder services, were also similar to that of certain Brazilian cities, as interviews with officials and practitioners confirmed. The criteria for city selection flowed from this: Curitiba's transport system planning and operations served as an example of what South African urban transport policy aimed to achieve, i.e. Curitiba had a hybrid bus rapid transport system functioning on trunk and feeder lines and an integrated transport planning authority. Sao Paulo had a modally fragmented planning and operational structure that reflected the institutional structure and modally diverse trunk and feeder transport network of Cape Town. In order to limit the number of interchanges that were documented, officials in the respective cities were interviewed and, based on their knowledge of the order of user volumes utilising those particular facilities and the trunk-feeder requirement outlined above, the final selection of three comparable cases per city was made.

2.3.2 Data Collection Instrument

The information that was to be gathered with the data collection instrument had to be a comprehensive reflection of the user transfer experience at interchanges. Subsequently, it was necessary to select a data collection instrument. It had to allow for the collection of information about the range of elements that influence the user transfer experience. However, before an instrument could be selected, it was necessary to develop a more detailed understanding of these elements. This was done by identifying the types of users who utilise interchanges, the functional components of interchanges, the tasks that users perform during transfers and the physical and information provision obstacles affecting user transfers, as described in Chapter 4. Through this process it became evident that it was not only the user's experience that should be documented, but also the institutions that managed and operated the public transport networks and interchange facilities or

their modal components, the types of public transport services and vehicles serving the interchanges, the accessibility and wayfinding characteristics of interchanges and transport services, and the available amenities that influence the user's experience. No pre-existent instrument could be identified that would be useful for this research. Thus an instrument was designed to collect data on the identified elements through interviews, observations, visual material and documents (Miller & Salkind 2002: 163).

Interviews with interchange officials and public transport operations staff on site provided data on the details and organisation of the institutions that managed and operated the interchanges and public transport services. Structured observations (Neumann 1994: 263-264) were used to document the accessibility and wayfinding characteristics of interchanges and public transport services and amenities available to users and staff at interchanges. Visual material, in the form of photographs, documented the general appearance of interchanges and public transport services, while also supporting the structured observation by documenting accessibility and wayfinding characteristics and the appearance of amenities. Lastly documents, in the form of brochures, pamphlets, and books, were collected detailing the nature of the respective public transport networks and management and operational institutions, as well as layout plans and aerial photographs of the interchanges.

Once the data collection instrument was applied to the case study sites, it was refined to take into account details that were not initially covered. It was found that no allowance was made for documenting the presence or absence of management facilities at interchanges, and this change was subsequently incorporated in the instrument. Also, after application of the instrument, it was found that data was being collected that was not required to address the research questions, and the instrument was suitably adjusted. The data collection instrument is presented at the end of Chapter 4 of this dissertation, and the complete findings for all the sites can be found in the Appendix.

2.3.3 Role of the Researcher

Besides undertaking the literature review and developing the data collection instrument I, as the researcher in this project, also applied the data collection instrument. In order to collect the data, it was necessary to observe public transport users while performing transfers, as well as the context within which the transfers occurred, i.e. public transport interchanges. I adopted the role of marginal participant observer at each of the study sites, a term which is used in ethnographic studies to describe a research role involving direct, i.e. on site, observation of human activities in the context in which they take place (Robson 2002: 310, 318). In the field of transport this activity is often referred to as a visual audit, although, in the context of this study, the data collection process involved thoroughly structured, on-site assessments, as opposed to a desktop review of such sites. A number of actions were necessary on my part before data could be collected in this

manner. The sequence of these actions, including the actual data collection process, is described below.

I was already familiar with the public transport network and a number of interchanges in Cape Town, and the public transport network of Sao Paulo, before commencing with this research project. Thus a large number of the elements influencing the user experience during transfer were already known to me or observed through personal experience in the respective public transport systems. The data collection instrument was based on this knowledge, which also forms the basis of the content presented in Chapter 4. After the instrument was designed, the case study sites had to be selected at which the instrument was to be applied. Since the time allocated for travel to Brazil commenced very soon after the completion of the design of the instrument I decided to commence with data collection in Brazil.

Before departure to the first destination, Sao Paulo, I had arranged contact with the agency managing bus terminals in the municipal area (Socicam). After arrival, and in collaboration with officials from this organisation, I identified three interchange sites that fit the desired criteria. These officials also obtained the mandatory permission from the agency managing the buses at the bus component of the interchanges (SPTrans) for my visits, and thereafter accompanied me to the first site to introduce me to the staff and allow me to collect the data. On the following day I made my way to the remaining two bus facilities to apply the instrument. However, each of these sites also had a separately managed rail component, two overground and one underground. I had to obtain separate permission from each operating agency (CPTM and Metro, respectively) to collect data. At the underground station I showed a letter of permission that I had collected from the central Metro office and was allowed to collect the data unaccompanied, while an official from CPTM met me at the one overground site and also accompanied me to the other site to collect data, without any need for official documentation.

In Curitiba, I obtained the details of the central urban planning authority, IPPUC, and received a briefing about the functioning and history of the public transport system of the city. Thereafter, IPPUC officials put me in touch with an official at URBS, the central transport management agency, who that same day helped me to identify appropriate study sites and arranged for a group of URBS terminal inspectors to transport me to the three study sites the following day to collect data.

Upon returning to Cape Town, I contacted officials at the public transport branch of the municipality, who assisted me in identifying suitable interchange sites and provided me with a letter permitting me to collect data at the minibus and bus components of those sites. Each site also had a separately managed rail component, and I contacted the management agency (Metrorail) to obtain the required letter of permission to collect data at the rail facilities. I visited each of the three sites on consecutive days, and collected

data for all components of the interchange on the same day. This was in line with my experience in Sao Paulo: because the modes were managed and operated by separate institutions in that city (as in Cape Town), having access to the bus facilities did not automatically imply that I could collect data at the adjacent rail station. In the end I had to revisit each site in Sao Paulo to document the rail component, since I did not arrange access in advance via the two rail service operators. Thus I adjusted my approach in Cape Town accordingly by first identifying *all* the relevant operators, and then obtaining advance permission to collect data for all modes on the same day. Once permission was arranged, data collection proceeded as follows: at two of the bus and minibus facilities I identified myself to the highest ranking official, after which a guard accompanied me while collecting data, while at the third interchange I was unaccompanied as there was no management staff present. At all the rail facilities, after identification to the station manager, I was allowed to collect data unaccompanied.

Once all the data was collected, the findings of each study site was compiled and arranged in tables that allowed for comparison between the corresponding elements of each interchange. The findings and the comparative tables can be found in Chapter 5. The ultimate aim of this research project was to provide recommendations on how to improve the user experience during transfer at public transport interchanges. When the collective findings of the empirical research (that reflected the reality of interchanges) were compared to the results of the literature review (that reflected the theoretical, or planned, role of interchanges), it allowed certain conclusions and recommendations to be drawn. These conclusions and recommendations are presented in Chapter 6.

2.4 CONCLUSION

This chapter has discussed the two strategies that were followed to answer the research questions posed in the first chapter. The first strategy, to undertake a literature review, was developed to address the question on the policy and guidance that governs the provision of interchanges. The results of the literature review can be found in the next chapter. The second strategy, to conduct empirical research, was aimed at the second and third research questions, i.e. interchange as a process undertaken by a public transport user, and the comparability of data from various sites. These results are presented in Chapter 4.

3. LITERATURE REVIEW: POLICY AND GUIDELINES

3.1 INTRODUCTION

The purpose of this chapter is to describe the results of the first research strategy, i.e. a literature review, that was undertaken to answer the first research question: What direction does the regulatory and planning environment give to the design and planning of public transport interchanges? In order to respond to this question, this chapter reviews, in two parts, existing literature that relates to public transport interchanges. The first section of this chapter investigates public transport policy. South African public transport policy guides the aims and format of public transport networks through various documents produced at the national, provincial and local levels of government. These policies also provide input into the importance of the interchange as a critical part of the overall public transport system, and this assumption is tested in this section. The second main section of this chapter examines the content of existing guideline documents that direct the physical design and planning of interchanges. Various relevant documents that have been produced locally are presented to provide a broad view of the typical considerations that are taken into account when public transport facilities or interchanges are designed. Finally, a number of discrepancies and recurrent issues are brought to light in a systematic review of these guidelines against the background of the policy presented in the first section, and these are outlined in the conclusion to this chapter.

3.2 PUBLIC TRANSPORT POLICY

The policy documents that are presented in this section express the policy ideals for public transport systems and their components, including interchanges. There are a number of themes that recur in these documents, which directly or indirectly have an impact on the current functioning of interchanges but also affect the future importance and role of interchange facilities. The documents are grouped according to the level of government at which they are produced – firstly national, then provincial, and lastly at the local level of government, with an integrated summary at the end.

3.2.1 Draft Strategy to Accelerate Public Transport Implementation via a Win-Win-Win Partnership between Government, Existing Operators & Labour

(RSA-NDT 2006a)

The strategic vision for public transport, as presented at the outset of this document, is "to transform public transport service delivery away from operator-controlled, commuter based, uni-modal routes, to user-oriented, publicly controlled, fully integrated, mass rapid public transport networks," (RSA-NDT 2006a: 1). It continues by saying that such a public transport network should be delivered as an inter-modal system with good quality

services organised along city-wide corridors, in contrast to the existing modally-based public transport services (RSA-NDT 2006a: 6-7). In these statements it recognises a widespread problem that exists in public transport: that South African cities have modes that operate in isolation from one another, as opposed to a unified public transport network, and that such a system favours individual modal requirements over those of the actual end user of public transport.

3.2.2 National Land Transport Strategic Framework 2006-2011

(RSA-NDT 2006b)

The strategic framework states that public transport should receive higher priority than private transport. This reflects a shift in mindset away from supply-driven to demand-driven transport systems, but achieving this requires greater integration and cooperation between the three spheres of government. Transport plans should focus on integration in the planning of transport infrastructure and facilities and public transport services, amongst others, while also enhancing access to public transport services and facilities, including access for persons with disabilities. The document is also very clear about the importance of the recapitalisation of all road-based public transport modes, or in other words, a move away from mode-based transport to an integrated public transport network (RSA-NDT 2006b: 3-5).

3.2.3 Public Transport Strategy

(RSA-NDT 2007a)

The national strategy that provides direction for public transport provision outlines a number of desired elements in the public transport systems in the six metropolitan cities in South Africa, of which Cape Town is one. Integrated public transport service networks must deliver a user-friendly, high-quality system aimed at both public transport and current car users, operated by public entities (municipalities) rather than private operators. High speed road-based services will be delivered through dedicated travel ways in corridors, enclosed stations with payment before boarding, real-time travel information and at-grade boarding facilities onto vehicles, with feeder services that integrate directly with the main lines without the need to pay an additional fare. In such a trunk and feeder service the particular mode that offers the service will be rendered insignificant as all elements should operate as one entity, or system. However, the document states that networks should aim to minimise transfers through direct routing between nodes, which implies that transfers should not occur outside of nodes. Other infrastructural requirements include depots for vehicles over and above stations and terminals, while the latter two would be designed to be attractive, secure and easily accessible to all users (RSA-NDT 2007a: 5-7).

3.2.4 Public Transport Action Plan, Phase 1 (2007-2010): Catalytic Integrated Rapid Public Transport Projects

(RSA-NDT 2007b)

The Action Plan sets out in more detail the aims of the Public Transport Strategy document presented above (RSA-NDT 2007a). It reiterates the need for high service standards for a unified rail- and road-based public transport system, including integrated fare payment and free transfers, attractive station precincts and facilities, modern vehicles, a secure transport environment and good customer service. Two of the most critical points that the document raises are the following: the first is that municipality will act as the single authority that procures all aspects of public transport infrastructure provision and manages the transport operators; the second is that "[t]he focus of these networks is on the USER [original capitalisation]," which includes safety, security, cleanliness, reliability, comfort and image (RSA-NDT 2007b: 16-22). It leaves little doubt that a modally based, operator-controlled network is not desirable, and places considerable pressure on the local governments to increase their managerial capacity to address the status quo.

3.2.5 The Transformation of Scheduled Services in the City of Cape Town: Phase One

(PGWC-DTPW 2005)

The transformation charter for the City of Cape Town proposes a network structure for public transport that embraces four types of services: trunk (or "core") routes that run along corridors, which includes existing rail corridors; feeder and distributor routes that connect communities to the trunk routes; express (or "direct") services that follow trunk routes, but reduce the need for transfers; and direct services outside the trunk corridors. In order to ensure full integration between these routes the charter calls for an integrated, electronic fare collection system where fares are collected before boarding vehicles. Additionally, it aims to include users that are often left stranded in the current network: learners and passengers with special needs. Perhaps the most urgent, and challenging, intervention in the proposed system is the requirement that current minibuses be scheduled and merged with bus services into one, quality-controlled operation (PGWC-DTPW 2005: i-v, xvi-xviii). All the aforementioned proposals will most certainly have large-scale impacts on current infrastructure – it calls for truly universal accessibility, a major rethink of the role and nature of interchange facilities as primary transfer, fare collection and security points, and potential redundancy of duplicated facilities due to previous modally fragmented ranks, termini and stations.

3.2.6 State of Cape Town 2006 – Development Issues in Cape Town

(CCT 2006a)

In the face of a public transport system that lacks modal integration and good security and cannot compete with growing private car usage, the report suggests the establishment of a metropolitan transport authority that would better coordinate the actions of stakeholders. The report admits that large-scale upgrading and expansion of the city's public transport system is required to elevate the level of transport service so that it becomes a viable alternative to private car travel. It also states that important commercial and industrial nodes (including the city centre) should be connected by public transport to increase accessibility to employment opportunities (CCT 2006a: 50-53). While these statements are quite general, the terminology used echoes that of other policy documents in support of nodes that are linked by public transport. Of particular importance though, is the mention of a citywide transport authority: without integrated action at the strategic and planning end of the transport system, integration of actual operations might not be achievable or sustainable.

3.2.7 Integrated Transport Plan for the City of Cape Town – 2006-2011

(CCT 2006c)

A number of issues and policies relating to public transport are listed in the Integrated Transport Plan (these are duplicated in the subsequent Public Transport Plan (CCT 2006d) and thus not presented separately). The Plan largely reiterates the aims of various other policy documents. Amongst these ideals is a call for an overarching transport authority (104), the restructuring of existing bus and minibus services into a unified trunk and feeder-distributor system, "seamless" transfers between the different levels of services aided particularly by integrated fare management, and better matching of modes to service volumes, i.e. vehicles that respond to user demand rather than user demand having to fit into inappropriately sized vehicles. The needs of all users should be met, and, mentioned separately, persons with special needs should also be able to gain access to transport (CCT 2006c: 114-117).

The Plan recognises some important network capacity issues, which have an impact on interchange provision. Rail serves a wide range of destinations and socio-economic areas, but does not act on its strategic existing corridor positioning, as falling patronage indicates. This is partially explained by the lack or cooperation between the nationally regulated rail agency and the regulators of the minibus and bus modes. Buses offer widespread services but there are on average very few vehicles, and by extension passengers, per route; buses run feeder services that would be better addressed by smaller vehicles; and bus routes duplicate to a large extent both rail and minibus routes. Minibuses, in contrast to buses, offer too many vehicles on a large number of routes while

also carrying very high volumes unsuited to their small capacity (CCT 2006c: 109 -113). Reflecting the non-integrated planning evident within each mode at present, the document deals with the role of rail corridors (CCT 2006c: 119-120) as a wholly separate consideration from the restructuring of public transport services (CCT 2006c: 120-124).

3.2.8 Summary of Findings in Policy Documents

There is a question that the policy review has answered only indirectly: What is the relevance of policy to the planning and design of public transport interchanges? From the literature it is clear that regulatory agencies wish to move from a modally based mindset to a model based on the needs of the user. This necessitates the integration of modes and facilities, which are currently individually managed and implemented, into a fully functional, integrated system managed by a single authority operating at the local government level. The envisaged system will rely on high-volume trunk routes, from which feeder and distribution services radiate. The nodes where these two structural services meet (which can be nothing other than interchanges) will cater for large numbers of users and the activities related to their presence. Transfer at these nodes will be seamless, in other words barriers that prevent accessibility for all users need to be removed. This will be achieved by a single fare management and collection system that speeds up transfer and increases user-friendliness, and the removal of physical obstacles that will allow all users, regardless of their level of personal mobility, to successfully utilise public transport services and all facilities that provide access to such services.

Though various problems are highlighted in the policy documents, they recognise that the above aims have to be achieved if public transport is to serve all users effectively, starting with integration of the entities that manage all public transport functions. Furthermore, physical integration between modes will become increasingly important if policy is to achieve its ultimate goal, which is summarised in a presentation from the National Department of Transport as "[the] phased implementation of a single, user-responsive, publicly planned and controlled system, that integrates routes into a multi-modal mass rapid public transport network, and provides maximum accessibility and coverage in a city or district for all citizens," (Pillay & Seedat 2007: 5). The broader ideals for the public transport system are evident, but public transport policy does not seem to give a clear indication of the role of interchange facilities within such a system. What regulatory guidelines exist that inform the development and physical aspects of public transport interchanges? The following section responds to this question by citing guidelines for the design and planning of public transport facilities.

3.3 PUBLIC TRANSPORT FACILITY PLANNING AND DESIGN GUIDELINES

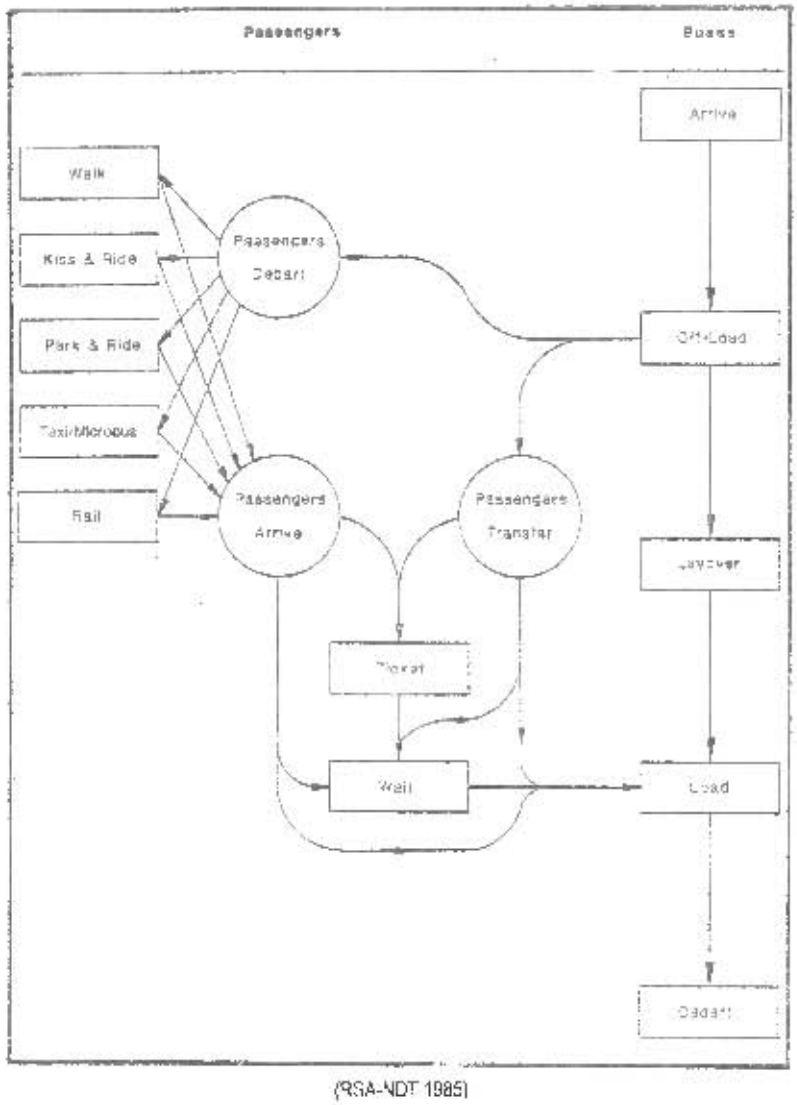
There are a number of guideline documents that inform the planning and design of public transport facilities in South Africa. This section reviews a selection of these documents

that are either some years old, but still in regular use, or that have been produced recently to complement or replace the older guidelines. The guidelines were produced at both the national and the local levels of government and are arranged here in chronological order, from the earliest to the most recent.

3.3.1 Bus Terminals and Bus Stations: Planning and Design Guidelines

(RSA-NDT 1985)

This report is perhaps the first comprehensive, locally produced document that deals with the design of public transport facilities, albeit only for use when designing for buses. The bulk of the document focuses on accommodating the bus as design vehicle, i.e. providing adequate loading berths in a range of layouts, circulation and turning space, passing lanes and holding spaces, and the like, along a hierarchical arrangement dependent upon bus and pedestrian volumes and location. It does not deal in detail with the requirements of users. It recommends, for instance, "that pedestrian circulation and flow should be considered at a very early stage and should exercise a prime influence on the choice of layout or a terminal," and that "[e]very effort should be made to enable walkways to follow the natural pedestrian paths," (RSA-NDT 1985: vii) but does not offer any further direction on how this should be achieved. The way in which user needs influence the facility layout is only defined in terms of possible safety conflicts with buses and an awareness of existing desire lines. Under user requirements, it lists considerations in the choice of queuing arrangements, levels of service (or spatial allocation) at boarding platforms and walkways, the need for staircases, escalators and bridges, design volumes, pedestrian circulation and control, and sheltering and roofing. The functioning of bus terminals are largely determined through technical specifications that do not reflect the quality of the user experience, nor is the provision of amenities such as park-and-ride, toilets, service information and vending seen as being central to fulfilling the needs of users. The quality or characteristics of the links between terminal components are not described, even though the presence of such links is recognised, as demonstrated in Figure 3.1 below.



(RSA-NDT 1985)

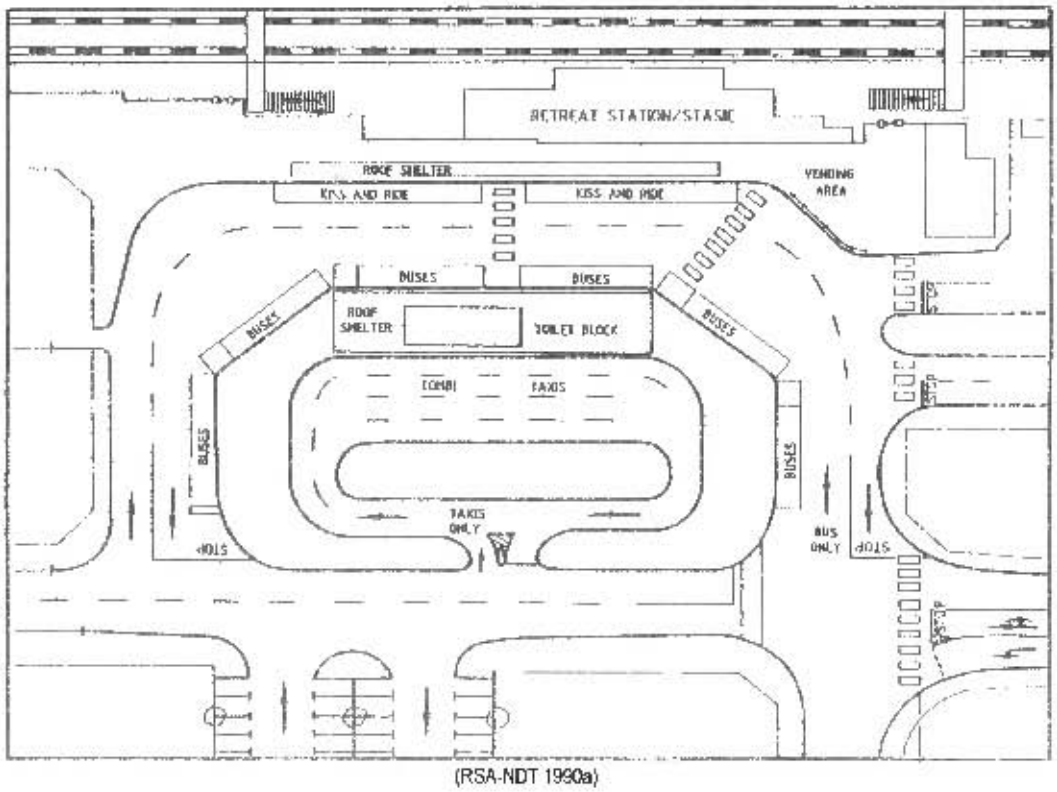
Figure 3.1: Major bus terminal functions

With regards to the then budding minibus-taxi industry, the report advises separation of the respective facilities to minimise circulation conflict, but that all facilities should be equally accessible. Where there is a bus-rail transfer point, it recognises that modal transfer is unpopular with users; hence the design of such facilities should provide a sufficient degree of convenience for the users, with fare integration and proper management, security and cleansing also being desirable. The link between bus and rail should also provide adequate shelter and be surfaced and well drained. In the end it is clear that the guidelines are not intended to provide direction for integration with other modes, but rather on the internal considerations for designing terminal and station facilities to accommodate a single type of vehicle, that is, the standard high-floor bus.

3.3.2 Guidelines for the Design of Combi Taxi Facilities

(RSA-NDT 1990a)

The national guidelines for combi taxis (i.e. minibuses) arose out of a need to provide facilities specifically for vehicles with different parameters to buses, that is, of a smaller standard size, operating on an unscheduled basis and regulated internally. Besides this distinction these guidelines are largely a duplication of the guidelines for buses in terms of structure and content. Whereas mention is made of the need to integrate the provision of minibus facilities with other transport planning activities due to the need for interchange between different modes, the solution given is to provide separate facilities for each mode, with a minimum of management of the passenger transfer in between. In the example given of such a multi-modal transfer facility at Retreat station in Cape Town (Figure 3.2), zebra crossings at street level and close proximity appear to be the only attempts at integration.



(RSA-NDT 1990a)

Figure 3.2: Bus-rail-combi taxi transfer facility (Retreat, Cape Town)

The document urges that the needs of the passenger, operator and community should be identified, but the design objectives centre on the safety and accommodation requirements of the vehicle. The scope of passenger considerations is limited: user convenience and safety is to be achieved by minimising walking distances and passenger-vehicle conflict, and the design of the facility is determined by queue lengths,

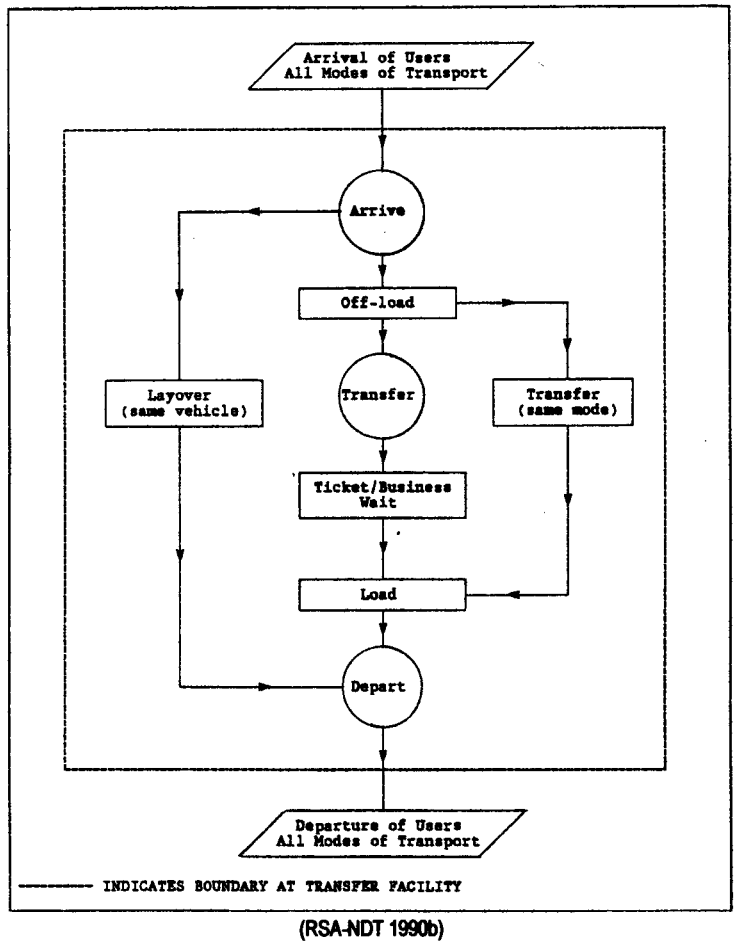
waiting times, walking distances and numbers of transfers. As in the guidelines for bus facilities, there is a list of amenities that could be included in a facility. However, here it is stated that this is for the comfort and convenience of passengers and vehicle drivers, even though such provision should be balanced with the amount of space that is required. Ultimately, it is not amenities or user convenience that determines the size of a facility, but rather vehicle and passenger demand for space. Facility design remains a quantitative consideration, not a qualitative one.

3.3.3 Guidelines for the Provision of User Information at Modal Transfer Facilities

(RSA-NDT 1990b)

An important component of successful passenger transfers is the provision of information regarding the transport services operating at a transfer facility and the layout of such a facility. This report recognises the importance of, and the need to provide, such information. It gives guidance on the provision of visual, oral, distributive (e.g. system and route maps) and automated communication aids for a range of users who are categorised according to the level of information that is required to utilise a facility and transport network successfully. These categories are, from lowest to highest level of demand for information: regular public transport users; regular users who are temporarily travelling in an unfamiliar part of the city; incidental users who are familiar with the city but not the public transport system; and visitors who are unfamiliar with both city and transport system. The guidelines are formulated for able-bodied users, with the needs of users with disabilities not integrated into the relevant sections and treatments, but rather mentioned in brief as a separate consideration.

Of perhaps the greatest significance to the design of interchange facilities is the inclusion of a diagrammatic representation of the path that a user follows when transferring between different modes or vehicles (Figure 3.3). Even though at the time of the report's production facilities and operations for each mode were planned in isolation, it shows that there was cognisance of the need to address the link between modes. It recognises that comprehensive information provision is one of the basic components of successful modal interchange, even though operational integration is not seen as a central design consideration.



(RSA-NDT 1990b)

Figure 3.3: Interaction of transport modes at transfer facilities

3.3.4 Pedestrian Safety at Public Transport Interchanges

(CCT 2001)

The objective of the report is to provide safety standards at public transport interchanges and to contribute to creating a safer environment in and around interchanges for the user. Its objectives of attaining safety standards at interchanges and prioritising a safer environment for interchange users are supported by its clear definition of public transport interchanges and its primary users. The interchange includes "the core area set aside for the transfer of passengers, associated holding areas, together with such components of the surrounding environment where significant identifiable pedestrian access pathways are present with the walkable catchment area of the interchange," (CCT 2001: 1). The interchange user is any person moving within this area on foot, standing or seated while outside a vehicle, including operating staff and informal traders. The multi-modal interpretation of the nature and utilisation of interchanges is shown in an accompanying diagramme (Figure 3.4). The comprehensive point of view means that it is possible to analyse and influence the entire user experience while at the interchange or when

transferring between modes. instead of being limited to the spheres of each individual mode.

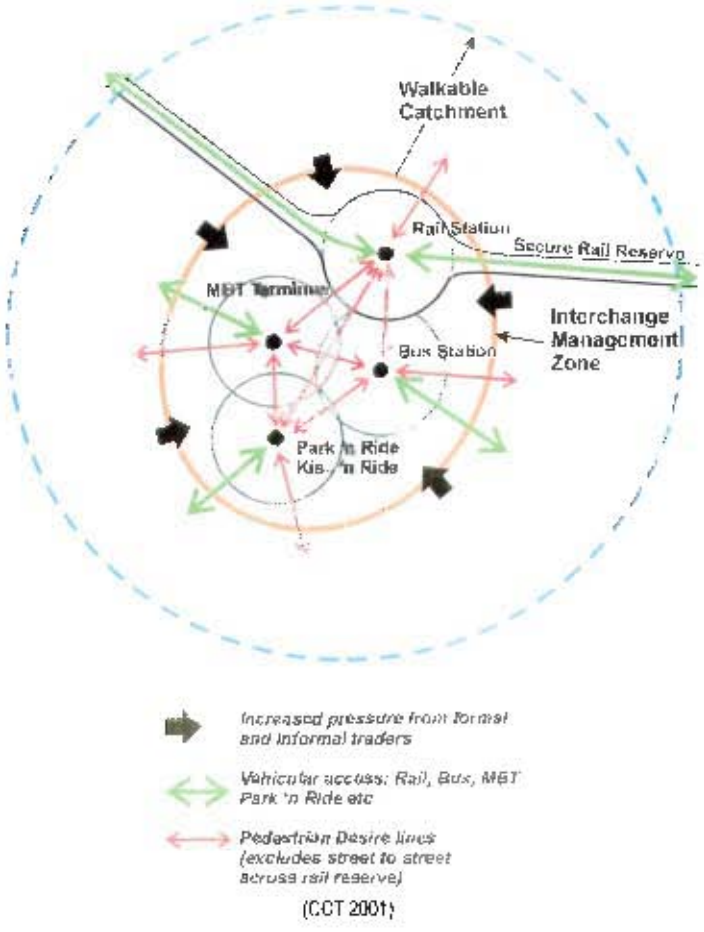


Figure 3.4: Pedestrian safety at public transport interchanges – spatial layout

The main safety issues that are investigated are pedestrian-vehicle conflicts (at-grade crossings or where obstacles or lack of space force users to walk in a roadway), personal safety (e.g. lack of universal accessibility, poor guidance information and security risks) and emergency situations. A visual audit at the Wynberg interchange, which served as a pilot study, confirmed that many of these issues were poorly addressed, especially when all the functional parts were seen as belonging to a single facility that aims to expedite the movement and transfer of users. Perhaps the most significant fact to emerge from the audit was that linkages between modes did not accommodate all users, with almost all links being poorly lit, inadequately surfaced and generally unsafe.

3.3.5 Planning and Design Guidelines for Public Transport Interchanges in Gauteng

(GPG-DPTRW 2002)

In the introduction to the guidelines the importance of high quality interchange is recognised as a crucial part of a successful public transport system and of successful integration. Integrated transport, it states, encompasses integration within and between different modes for easy user transfer and modal functioning, but also integration between transport and land use planning, the environment, and policies for education, social upliftment and health. Even though integration is a central focus of policy, the report acknowledges that this is not reflected in public transport operations. The guidelines were developed in response to the following needs that emerged from consultations with officials:

- To ensure that appropriate stakeholders were involved in planning and design
- To ensure the proper estimation of passenger demand and correct levels of service
- To ensure a balance between transportation elements, urban design, architecture and commercial opportunities
- To ensure that passengers are the central design focus
- To ensure that interchanges are people-oriented sites. This was in response to the oversupply of loading bays and thus the increased presence of vehicles informally parked at interchanges.
- To provide an operational management plan
- To provide for new design vehicles

Other issues were the inclusion of safety and security provision in the planning phase, a need for more standardisation and less inconsistency, and clear consultation and approval procedures. The latter two issues might be explained by each mode and operating authority having essentially its own set of planning guidelines, with little direction given in case of overlapping responsibilities, as is the case at interchanges.

However, in contrast to the objectives of the report, as stated above, there is no guidance given as to how integration between modes should be achieved or managed, nor is there an attempt to examine or control the experience of the user while transferring between modes. The guideline information consists mainly of content reproduced from existing mode-specific guidelines: bus guidelines (RSA-NDT 1985 reviewed above), minibus guidelines (RSA-NDT 1990a reviewed above), national pedestrian and bicycle facility guidelines and South African Rail Commuter Corporation (SARCC) station design documentation. The problems inherent in the respective guidelines are thus carried over,

i.e. a modal bias, a focus on specific vehicles and a lack of guidance on the transfer process, on integration and on qualitative criteria governing the user experience.

3.3.6 Design Guidelines for Public Transport Facilities

(CCT 2005b)

The document provides guidelines for the planning and design of public transport facilities in Cape Town. It has four central themes: to establish an approach to public transport facility design that views it in its total urban context, to consider the needs of new vehicles as required by the government-driven vehicle recapitalisation process, to learn from the experience of recently designed facilities, and to focus on the needs of the pedestrian as the primary design component of public transport facilities. It recognises that there are a number of components that constitute an interchange:

- Vehicular layout – access and circulation, interchange operations, civil infrastructure
- Pedestrian space, circulation and facilities – circulation, loading, shelter, building structures, landscaping, furniture, lighting
- Trading – formal trading with storage facilities, refuse storage, informal trading corresponding to pedestrian presence
- Signage – information, communication
- Management – management, staff, security, disaster control, maintenance, cleaning, refuse storage and collection

The document offers a thorough analysis of existing facilities based on these components. Issues emerging from the analysis are then addressed in the guidelines that it generates, and in the pilot project in which it engages. The most notable problems are that facilities are not flexible enough to deal with changes in vehicle supply and passenger demand and would require modifications, substantial trading is generated by users but encroaches on user movement, vehicles encroach into pedestrian space and loading platforms are often too narrow for safe boarding and waiting, universal accessibility is not provided throughout, there is inadequate shelter against rain, bicycles are very poorly accommodated, and information and wayfinding are not provided in a comprehensive manner.

Even though the guidelines offer substantial input on qualitative issues affecting the user experience, they are still vehicle-specific and might thus not offer the flexibility that the document admits is necessary. This might be explained to some extent by the fact that the document relies strongly on input from the national bus (RSA-NDT 1985) and minibus (RSA-NDT 1990a) facility guidelines and the Gauteng interchange planning and design guidelines (GPG-DPTRW 2002). It also does not address modal integration: the

guidelines cover road-based modes by vehicle size, while omitting rail entirely, with no input on the management of the user transfer process between modes. Indeed, interchange operations, as defined in the text, are a function of vehicular layout and not pedestrian movement. These problems reflect the reality that public transport practice and institutions continue to be mode-based, as opposed to policy that clearly prioritises the user.

3.3.7 Summary of Findings in Guideline Documents

There is some progression visible in the mindset of public transport if one looks at the locally produced guidelines reviewed above, from the first national guidelines for bus facilities to the latest guidelines for public transport facilities. While the earliest documents are specifically mode-based and deal only very briefly, if at all, with linkages to other modes to which passengers might wish to transfer, the latter clearly include more than one mode in their analyses and recommendations. It is also evident that there is a need to better integrate the management of, and planning for, all modes present at an interchange in order to improve the user's experience of the facility. Also, from an overt technical orientation in the earlier documents that deals mainly with supply and demand of vehicles and passengers, the scope has been significantly broadened to include many qualitative aspects of public transport facilities, such as guidance on how to create attractive facilities and also on how to unlock the social and economic potential inherent in larger facilities and the importance of effective universal access provision.

There are, however, also some major issues that belie the apparent progression. Each successive document reproduces to a very large extent the contents, and thus inherently the flaws, of the previous guidelines. Universal accessibility remains an add-on feature, instead of being an inherent part of the design process. The facilities continue to be designed around specific standard design vehicles, limiting the ability of facilities to accommodate different vehicles in future. Also, the diagrammes presented in the text illustrate that from the very first there was a realisation that one mode is linked to other modes, but even in the most recent document, the Guidelines for Public Transport Facilities in Cape Town (CCT 2005b), there is still no indication of how the linkages between modes and the layout of interchanges can be improved to better accommodate the needs of the user during transfer. The title of this document is also somewhat misleading in that it does not deal at all with the design of rail facilities, even with rail being a prominent component of Cape Town's public transport network.

The mindset continues to be internally focussed on each mode as a separate entity. It is ironic that the continued separation of modes and the focus on vehicular design that is evident in the guidelines in reality force users to weave between vehicles at and around public transport facilities and add to potential conflict points, while the same guidelines (e.g. CCT 1990a: 10-4) also proclaim pedestrian safety as a primary design consideration.

When modes co-locate to enable transfer between them they are readily called interchanges, but there is little guidance for, or management of, the actual act of interchange. That is, the entire trip that the user makes from the time of alighting from one mode or vehicle to the boarding of another mode or vehicle, including the information necessary to complete such a trip and the obstacles that a user might encounter while making the trip.

3.4 CONCLUSION

This chapter has highlighted two components of the argument presented in this dissertation. The first component consists of regulation, in the form of public policy, that stipulates the aims and ideals towards which public transport provision in South Africa should strive. In particular, public transport policy outlines the role that interchanges play as the nodes at which transfer between the various envisaged public transport services occur, and provides an indication of the planned measures aimed at making the public transport system more efficient. These measures, as outlined in this chapter, include a transport system that prioritises the user over the vehicle, integrating the different planning and operating bodies into one structure that collectively manages and operates a network of trunk and feeder services, the development of a single interoperable fare collection system, and the provision of comprehensive universal accessibility. All these measures directly or indirectly affect the way in which interchanges work.

The second component of the argument is based on the guidelines that currently direct the planning and design of interchanges in South African cities. There is an array of documents produced at both the national and local levels of government that provide a common source of reference for the planning authority and practitioner alike when developing public transport facilities. As illustrated in this chapter, each document tends to build on the contents of the preceding document, adding refinements and broadening the scope of the guidance provided. However, even the most recent of these documents does not reflect the thrust of public transport policy, that is, a public transport system that provides integration across all modes for all users. Perhaps the most comprehensive guideline document to date, the Planning and Design Guidelines for Public Transport Interchanges in Gauteng (GPG-DPTRW 2002), both states and illustrates the problem. It states that, while policy and transport plans alike have supported modal integration for a number of years, there is no clear understanding of what modal integration and interchange is in practice. Because users are naturally opposed to transferring between modes or vehicles (GPG-DPTRW 2002: 6), the guidelines were developed to target and improve the quality of interchange design and planning. However, these guidelines are essentially a collection of the older vehicle-specific guidelines. Thus, they are highly mode- and vehicle-specific, lack consistent and integrated content that could guide a planner to provide an improved transfer experience for the user, especially when it comes

to layouts of interchanges and the relationships between different modes that could reduce vehicle-user conflict, and ultimately fail to reach the stated objective.

If policy requires that public transport facilities are user-oriented, but existing guidelines are dominated by the needs of the vehicle, then what is the actual experience of the user during transfer at an interchange facility? The empirical research that was undertaken as the second research strategy of this project, in the form of a comparative case study, responds to this question. The findings of the empirical research are described in the following two chapters. Chapter 4 describes the process that ultimately led to the development of the data collection instrument, while Chapter 5 presents the findings that emerged from the application of the data collection instrument at the study sites.

4. CONCEPTUALISING AND EVALUATING INTERCHANGE

4.1 INTRODUCTION

There are a number of concepts that describe public transport interchanges, and user transfers in such facilities, that inform an understanding of the user experience at interchanges. This chapter describes such 'concepts of interchange', which include the user characteristics, functional components, transfer trip chains and obstacles that describe the user transfer experience at interchanges. This chapter also presents the criteria for evaluating the user transfer experience that emerged from the conceptualisation process and the data collection instrument that was developed from these criteria. The data collection instrument was subsequently applied at all the study sites, and these findings appear in the next chapter.

4.2 USER CHARACTERISTICS

The national focus on providing a fully integrated, user-oriented (as opposed to a differentiated, operator controlled) public transport service necessitates an interrogation of who those users are and what their particular transport needs are (RSA-NDT 2006a: 1). The entire range of users should be able to utilise all facilities and vehicles in an integrated public transport system, and this includes public transport interchange facilities. Thus the design of interchanges, and an analysis of which obstacles they present to effective modal transfer, must take into account the full scope of user characteristics and needs.

Contemporary concepts in integrated transport, such as universal accessibility, disability integration for people with disabilities and transport disadvantage, describe the needs of users who are often marginalised by traditional design and planning in the transport and urban systems. Users are variously grouped according to disability or disadvantage, as a novice or experienced user of the transport system, or by life stage - youth, adult, or aged. As all these concepts aim to be inclusive rather this discriminative, it is not surprising that there are a number of interrelations between the different user characteristics. However, to streamline user groups with the analysis of transfer obstacles, user descriptions have been consolidated into four spheres of ability: physical, sensory, cognitive and financial. Disabilities become abilities if obstacles are removed (Davies 2005: 2). Thus an understanding of the types of obstacles that *disable* users at interchange facilities can inform design solutions that *enable* users to transfer effectively.

4.2.1 Physical Ability

Physical ability refers to the level of mobility that is necessary to perform daily tasks. Physical mobility is determined by an individual's muscular, skeletal and nervous systems. Examples of users whose mobility is limited through their physical condition are children, the aged, pregnant women and people living with arthritis, amputation or paralysis.

Vertical and horizontal dimensions, reach ranges and gradients are important considerations for this group of users.

4.2.2 Sensory Ability

The senses allow a persons to perceive the surrounding environment, and are often dominated by vision and hearing. The partially sighted or totally blind and hard of hearing or profoundly deaf are instances of people living with limited sensory ability. The aged are often also affected by such disabilities. A reduction in, or loss of, the functioning of these senses can be accommodated through appropriate signage, lighting, audio indicators, noise control and surfaces.

4.2.3 Cognitive Ability

A person's cognitive ability allows for interpretation of, and interaction with, his or her surrounding environment. Intellectual disability, associated with conditions such as autism or Down's syndrome, and cognitive disability, due to immature or advanced age or head injury, can restrict a person's environmental understanding. Transport users new to an area, wishing to change to public transport or unfamiliar with the dominant language also lack full cognitive ability. Clear signage and information displays at regular intervals, pictograms instead of text where possible and trained support staff enable these users.

4.2.4 Financial Ability

The financial ability of an individual influences where and how opportunities are accessed. Users captive to public transport, due to financial limitations, would benefit from trading and amenities located within or around interchange facilities, as it could condense a number of trip purposes into one trip. Since interchanges, as the hubs of transport systems, are the site of concentrated footfalls, they also offer a potentially vast opportunity for economic development. These opportunities should not, however, interfere with the process of transfer, which is still the main function of interchanges. (Davies 2005, Denmark 1998, TCRP 1999: 32-40)

4.3 FUNCTIONAL COMPONENTS OF INTERCHANGES

Public transport interchanges consist of a number of functional components, which can often also be delineated in spatial terms. These components have been conceptualised from observations at interchange sites in Cape Town and also elaborated from the basic modal transfer diagrammes presented in the literature review (CCT 2001; RSA-NDT 1985; RSA-NDT 1990a; RSA-NDT 1990b). The components presented in Figure 4.1 are the various functional parts of an interchange that a user would utilise during a transfer between the indicated origins and destinations. It is important to note that, while the name of a component as used in this dissertation might appear to relate only to formal facilities, the functional description in the context of this dissertation has a more universal definition.

The local transport system has a formal and an informal side to it, thus the function is of greater importance in this dissertation than the name. Hence the platform function is inherent in the traditional *boarding platform* at a train station, but it can equally be the sidewalk from which a user boards a minibus. Both instances describe the functional space where a user would disembark from or embark onto a vehicle. However, this dissertation is only concerned with the functional components in their application at interchanges, as outlined in Figure 4.1 and detailed thereafter.

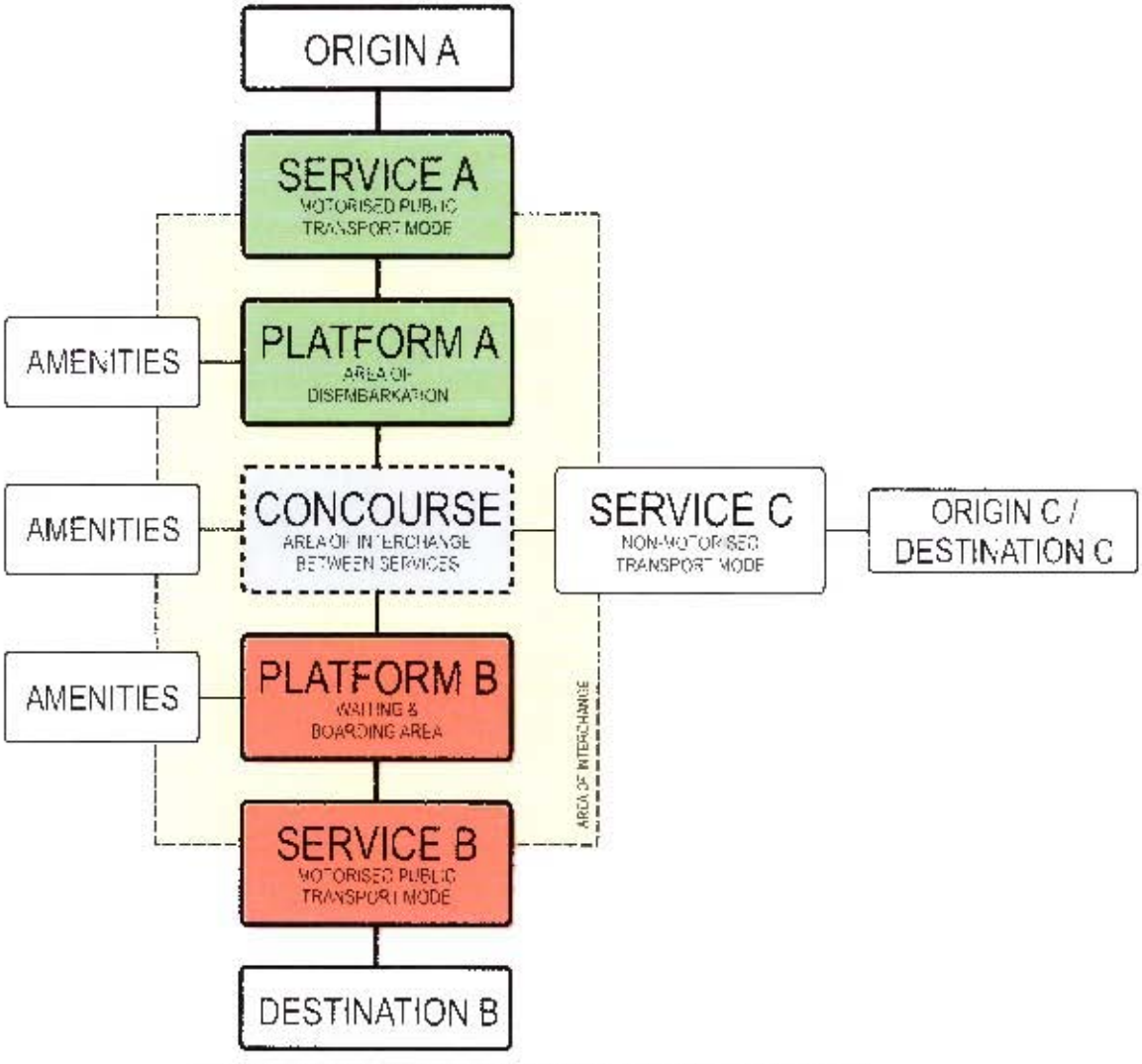


Figure 4.1: Spatial components of public transport interchanges

4.3.1 Origins / Destinations

These are any origins or destinations, distant or in close proximity to an interchange facility, that are served by motorised and non-motorised transport services from such an interchange facility.

4.3.2 Services

This term refers to transport services that serve an interchange. Such a service may be a line haul or feeder motorised public transport service, operating on a schedule or not, or a non-motorised service. Non-motorised services connect interchanges to adjacent land uses and to transport services that do not serve the interchange facility directly, while motorised services usually serve more distant destination and origins. There are also private motorised services that operate at interchanges. These are primarily taxis, park and ride (i.e. a user using his or her car as a feeder up to the interchange and then transferring onto public transport), and kiss and ride, which is where the driver of a private car would drop passengers wishing to transfer to public transport outside an interchange.

4.3.3 Platform

This is the area from which embarkation onto and disembarkation from a public transport service occurs. Waiting for the arrival of public transport vehicles is also an activity that occurs on platforms. A platform may have access control and perimeter barriers, or offer unrestricted access to a transport service. A platform may also be fragmented by the travel paths of the vehicles that provide the transport service into a number of loading areas. In such cases, the platform would then have walkways, overpasses or underpasses connecting each loading area to the next.

4.3.4 Concourse

The concourse is the area that connects the different platforms and allows non-motorised services access to the platforms. The concourse is the area that users have to traverse in order to change between transport services, but it is not necessarily a discrete place, especially at informal facilities.

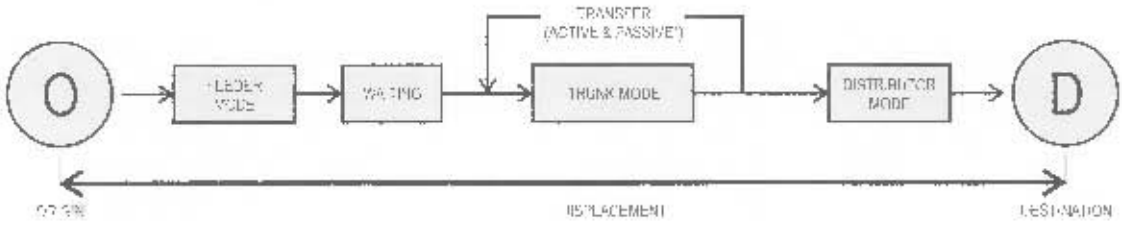
4.3.5 Amenities

Commercial or convenience activities not directly related to modal interchange. Commercial activities include formal and informal trade, while conveniences might be fare purchase booths or machines, seating areas, bicycle lockers and rental facilities, storage lockers, automated teller machines (ATMs), public telephones, public toilets or information counters, amongst others. These activities occur at various places along the transfer trip chain, with the possible exception of bicycle amenities, which tend to be in or around the concourse area close to the non-motorised service access.

4.4 TASKS DURING TRANSFERS

There are a number of tasks that a user has to perform during a transfer through the various spatial components of an interchange. These tasks are performed sequentially, and thus describe trip chains between the different services that serve a particular

interchange. The findings of a doctoral study at the Netherlands Research School on Transport, Rail and Logistics (TRAIL) gave an indication of what these tasks were (Van der Spek 2002). The aim of that study was to improve the user transfer experience at interchanges (or 'connectors', as used in the text) through hypothetical design interventions at problematic facilities in Amsterdam. In order to do this, the author developed an understanding of how a user progresses through different spaces at different stages of the transfer process. The following diagramme (Figure 4.2), translated from the original Dutch, describes a typical public transport transfer using trunk, feeder and distributor modes graphically. In the diagramme, active transfer tasks refer to movement, orientation and ticketing, while passive transfer tasks are waiting and the utilisation of amenities and commercial facilities.



(Van der Spek 2002, 69)

Figure 4.2. Basic transfer trip chain

Even though the diagramme is not comprehensive, it forms a good basis for further investigation. There may, in fact, be three transfer trip chains that occur in an interchange facility: a transfer between motorised services (as indicated above), an exit of the interchange from motorised services (motorised to non-motorised) and entering the interchange from a non-motorised service (non-motorised to motorised).

Since this project is primarily concerned with transfers between motorised services, it will focus on such trip chains. The trip chains outlined below give an idealised view of the tasks that a users might have to perform during a transfer, and have been inferred from a viewpoint of a novice user's experience in a transfer facility. However, some of these tasks may not have to be or cannot be performed if the design of an interchange does not require or accommodate it. It is, for instance, not necessary to pass access control if there is no access control point or device, or if there is no service information on display. The user would not obtain such information at that point and might have to resort to consulting another user. Amenities could be encountered anywhere between transfer tasks and in any of the components of the interchange, and thus their sequential location is indicative only.

4.4.1 User Tasks During Transfers between Motorised Services

The transfer tasks for a user transferring between two motorised services commence as the user disembarks from the vehicle of the initial service (*Service A*) – refer to Figure 4.3

below. At this point a user would confirm whether it is indeed the intended location at which he or she has alighted. From there the user would locate the platform exit and proceed past the access control point. Once in the concourse area, the user would find information regarding the service that would take him or her to the intended destination (*Service B*). In order to transfer successfully the user would information about:

- The best / quickest / easiest / cheapest route to the intended destination;
- The departure time of the next vehicle;
- Where fare vouchers can be bought and the method of payment;
- Which platform the vehicle departs from;
- How to get to the platform (Williams 2006: 11-12)

It would now be possible to proceed to the correct platform. The user would pass another access control point onto the platform, after which he or she would require information relating directly to *Service B*, confirming:

- Whether the current platform is the correct platform;
- Whether the next vehicle is the correct vehicle;
- Whether the vehicle will stop at the intended destination;
- Where the user should stand to board the vehicle (Williams 2006: 12)

The final tasks, before the transfer would be complete, would be to await the arrival of the vehicle, and upon arrival, to board the vehicle. The transfer trip, and individual tasks during this trip, are illustrated graphically in Figure 4.3 and Figure 4.4 respectively.

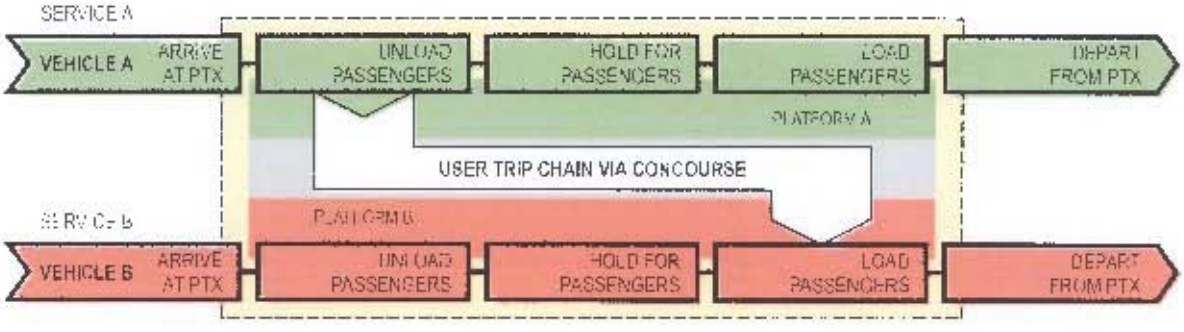


Figure 4.3: Transfer trip chain between motorised public transport services

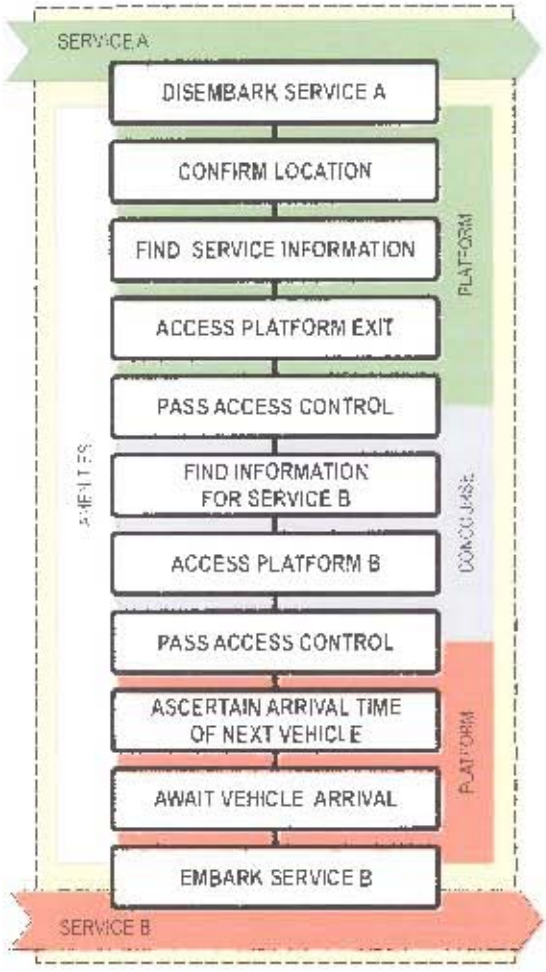


Figure 4.4. Transfer tasks during transfer between motorised public transport services

The trip chains when transferring between motorised and non-motorised services are as important as the transfer between motorised services, since they describe the tasks that a user needs to perform when exiting or entering the motorised transport system. In many situations non-motorised transport might be as important a feeder service as a motorised transport service, e.g. in a low-income area where most users cannot afford to use a motorised feeder service to access a line-haul service. These transfers differ from inter-motorised transfers in that there is a less complex access procedure. Non-motorised transport is not scheduled and does not require fare collection, thus there is no necessity for the platform function, and the need for information is more geographical and general by nature (e.g. adjacent street names, sites of interest and amenities). What is constant, though, is the series of tasks that relate to the boarding and alighting from motorised services, and the same questions could be asked by the user during this portion of the trip chain as presented above.

4.5 OBSTACLES

Where there is an inefficient or missing link in the transfer trip chain in an interchange facility, such a link may become an obstacle to efficient modal interchange. The obstacles that a user might encounter in an interchange are grouped and evaluated in two

categories in this paper, and trace the trip chains described previously to some extent. Firstly, there are physical obstacles that relate primarily to the dimensions of, and distances between, the spatial components and inter-leading access ways that are found at interchange facilities. Secondly, there are obstacles to successful wayfinding that arise from a lack of information regarding destinations and amenities within and beyond the interchange and the scheduling and routing of transport services.

4.5.1 Obstacles to Effective Accessibility during Transfer

Physical obstacles can be present at each of the various functional components of an interchange, as well as between each of these components, from the moment when a user disembarks from the initial service until he or she embarks upon the service that would go to the desired destination. The elements that can negatively influence accessibility during transfer are presented in diagrammatic form in Figure 4.5, followed by more detailed descriptions of each obstacle, and the way in which it could negatively influence the efficiency of a user transfer in an interchange in Table 4.1. The dashed line between 'Service C' and the concourse signifies an open or closed interchange system. If this line is the only place where access is controlled and fares are collected, the interchange is a closed system. Once a user is inside such a system he or she does not have to pass a fare collection or access control point again in order to gain access to transport services.

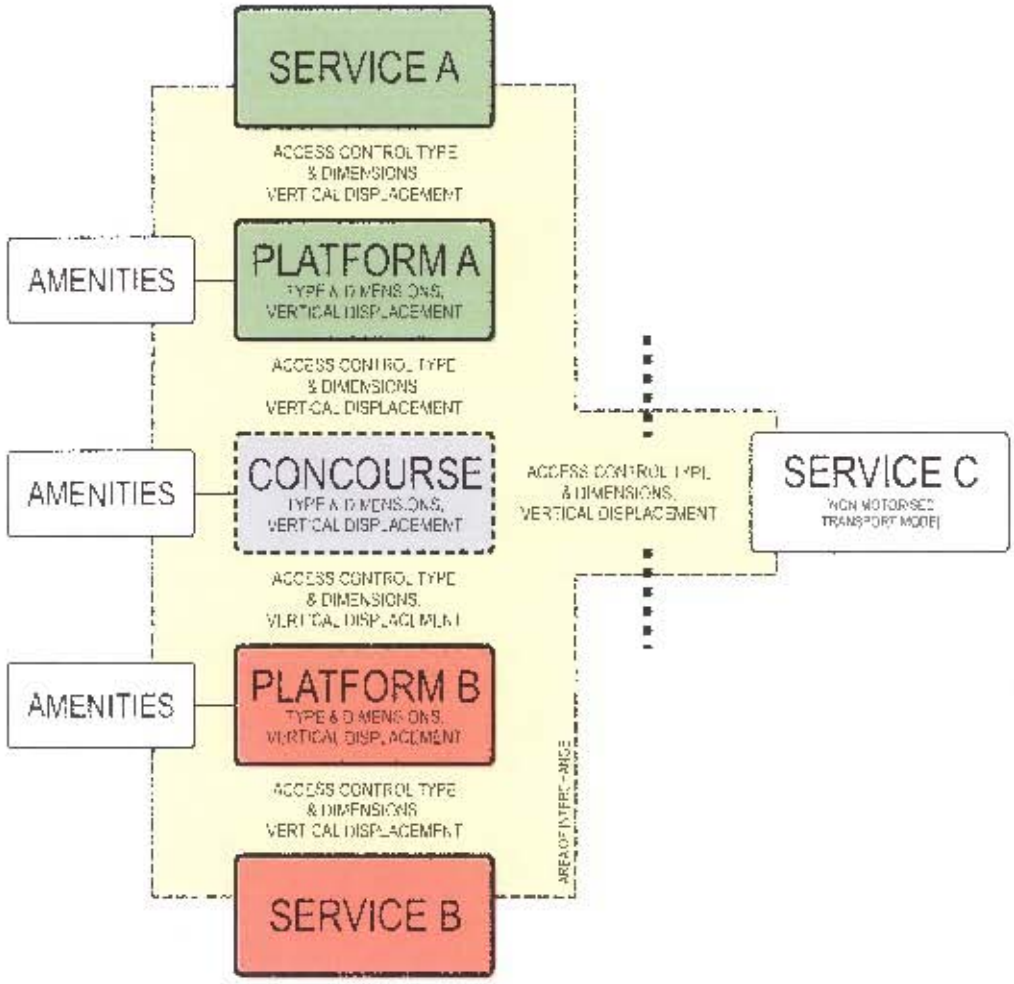


Figure 4.5: Elements of accessibility during transfer

Table 4.1: Accessibility obstacle measurement

ACCESSIBILITY	DESCRIPTION	PRESENTS AN OBSTACLE TO USER IF...
ACCESS CONTROL TYPE	Access control point or device and fare collection device	Time delay to negotiate access control or fare collection device Excludes some users due to complexity of operation
ACCESS CONTROL DIMENSIONS	Size and number of access control apertures	Queuing before access control Physical discomfort to negotiate access control or fare collection device Excludes some users
AMENITIES	Formal or informal commerce or convenience facilities located in interchange	Obstructs travel path during transfer Absence leads to user discomfort or inconvenience
CONCOURSE TYPE	Enclosure, surface, waiting area	Waiting or transferring is subject to climatic discomfort Surface quality or slope excludes some users No seating provided for waiting on concourse
CONCOURSE DIMENSIONS	Length and breadth, shape of concourse	Distance between services causes physical discomfort Distance between services excludes some users Concourse cannot accommodate number of users transferring
VERTICAL DISPLACEMENT	Level changes through ramps, staircases, escalators or elevators	Physical discomfort to negotiate Vertical displacement excludes some users Device causes queuing
PLATFORM TYPE	Enclosure, surface, waiting area	Waiting before embarkation is subject to climatic discomfort Surface quality or slope excludes some users No seating provided for waiting on platform
PLATFORM DIMENSIONS	Length and breadth, shape of platform	Distance between vehicle and exit / entrance causes physical discomfort Distance between vehicle and exit / entrance excludes some users Platform cannot accommodate number of users waiting to embark or disembark

4.5.2 Obstacles to Effective Wayfinding during Transfer

Information that supports wayfinding should be represented in a number of ways to accommodate all users. Oral instructions or announcements, maps, timetables and clear signage (TCRP 1999: 4) support successful wayfinding through a trip chain in an interchange facility, but also to adjacent locations and more distant destinations that can be reached by using the available transport services. The types of information that a user would look for during a transfer trip chain are shown diagrammatically in Figure 4.6. The lack of presentation of such information in a manner accessible to all users would constitute an obstacle to effective wayfinding. The manner in which these obstacles can be measured is illustrated in Table 4.2.

Note that Figure 4.6 should be read from an origin to a destination, i.e. *Origin A* to *Destination B* or *C*, and *Origin C* to *Destination B*. The breadth of wayfinding needs differs at each component of the transfer trip chain, thus the diagramme is not symmetrical, in contrast to the diagramme on accessibility in the previous section. Another difference between accessibility and wayfinding, which is reflected in the respective diagrammes, is that accessibility needs during transfer can be addressed within the boundaries of the interchange, while wayfinding needs go beyond those boundaries. In order to successfully complete a transfer, a user requires information regarding the transport network, service routes and external destination, over and above information on the interchange itself.

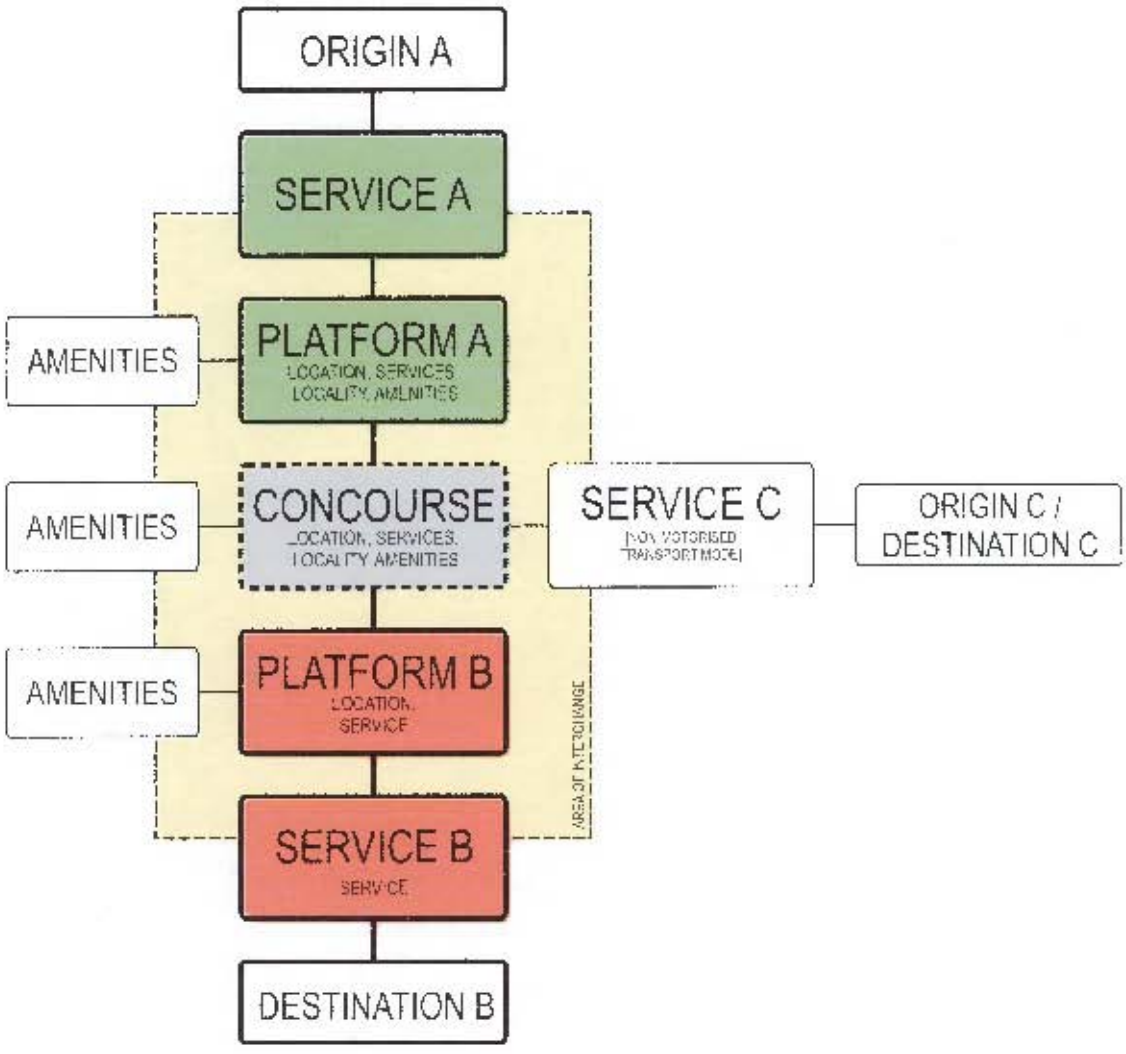


Figure 4.6: Elements of wayfinding during transfer

Table 4.2: Wayfinding obstacle measurement

WAYFINDING	DESCRIPTION	PRESENTS AN OBSTACLE TO USER IF...
LOCATION	Information establishing relative position of interchange component and providing place and / or interchange name ('you are here')	Information on spatial layout of interchange is not available User cannot locate transport services or other interchange components Name of interchange is not apparent upon disembarking Exits from interchange component and facility are not apparent Location and types of available amenities are not apparent, language
LOCALITY	Information on the location of geographical destinations, NMT routes, attractions and amenities external to interchange	Names of and ways to notable destinations external to interchange are not apparent, language
SERVICE	Schedule, route and platform layout information of transport services that serve the interchange facility	User cannot locate platform where transport services arrive at or depart from User cannot obtain schedule and route information for service User cannot confirm vehicle's route and destination before boarding vehicle

4.6 ASSESSMENT CRITERIA

The criteria used for the evaluation of obstacles to user transfers in interchange facilities draw together the interchange concepts presented in this chapter, i.e. user groups, spatial components, transfer task chains and physical and wayfinding obstacles. The descriptions of obstacles elaborated previously are linked to a typical transfer trip chain between motorised services, describing in a sequential manner the user experience during a transfer between motorised services with the obstacles related to this transfer in Table 4.3. Transfer tasks that are optional during a typical transfer, but that might present obstacles to the user during transfer even if not utilised, are indicated with an asterisk (*). The criteria for measuring the impact of a potential obstacle identify the impact that the presence of such an obstacle would have on a user attempting to complete the relevant transfer task successfully.

Table 4.3: Criteria for obstacle analysis

TRANSFER TASK	COMPONENT	POTENTIAL OBSTACLE	CRITERIA
Disembark service A	Platform	Access control type	Fare collection at vehicle exit causes time delay to disembark Excludes some users due to complexity of operation
		Access control dimensions	Number of exits from vehicle cause time delay to disembark Height difference between vehicle and platform excludes some users Aperture dimensions excludes some users or causes physical discomfort
		Platform dimensions	Platform cannot accommodate number of users disembarking from vehicle
		Platform type	Disembarkation is subject to climatic discomfort Surface quality or slope excludes some users
Utilise amenities*	Platform	Amenities	Amenities obstruct travel path to platform exit Absence leads to user discomfort or inconvenience Location and types of available amenities are not apparent
Confirm location	Platform	Location information	Name of interchange is not apparent upon disembarking
		Locality information	Names of and ways to notable destinations that can be reached from this interchange are not apparent
Find information for Service A / B	Platform	Service A information	User cannot obtain schedule, route and platform layout information for Service A (in case of intra-service transfer)
		Location information	Information on spatial layout of interchange is not available Directions to service B are not available
Access platform exit	Platform	Location information	Information on spatial layout of interchange is not available User cannot establish way to other interchange components Exits from platform are not apparent
		Vertical displacement	Physical discomfort to negotiate Vertical displacement excludes some users Device causes queuing
Pass access control	Platform - Concourse	Access control type	Fare collection before concourse access causes time delay Excludes some users due to complexity of operation
		Access control dimensions	Queuing before access control Excludes some users Physical discomfort to negotiate access control or fare collection device
Utilise amenities*	Concourse	Amenities	Amenities obstruct travel path across concourse Absence leads to user discomfort or inconvenience Location and types of available amenities are not apparent

TRANSFER TASK	COMPONENT	POTENTIAL OBSTACLE	CRITERIA
Exit interchange*	Concourse	Destination information	Names of and ways to notable destinations external to interchange are not apparent
		Location information	Exits from interchange are not apparent
		Vertical displacement	Physical discomfort to negotiate Vertical displacement excludes some users Device causes queuing
Access service B	Concourse	Location information	Information on spatial layout of interchange is not available Directions to Service B are not available
		Concourse dimensions	Distance between services causes physical discomfort Distance between services excludes some users Concourse cannot accommodate number of users transferring
		Concourse type	Transferring is subject to climatic discomfort Surface quality or slope excludes some users
		Vertical displacement	Physical discomfort to negotiate displacement device Vertical displacement excludes some users Device cannot accommodate number of users
Pass access control	Concourse – Platform	Access control type	Fare collection before platform access causes time delay Excludes some users due to complexity of operation
		Access control dimensions	Queuing before access control Excludes some users Physical discomfort to negotiate access control or fare collection device
Utilise amenities*	Platform	Amenities	Amenities obstruct travel path across platform Absence leads to user discomfort or inconvenience Location and types of available amenities are not apparent
Ascertain arrival of next vehicle	Platform	Service information	User cannot confirm schedule and route information for desired service
Await vehicle arrival	Platform	Platform dimensions	Platform cannot accommodate number of users waiting for vehicle Platform dimensions exclude some users
		Platform type	Waiting is subjects users to climatic discomfort Surface quality or slope excludes some users
		Amenities	Lack of seating leads to user discomfort
Embark service B	Platform	Service information	User cannot confirm vehicle's route and destination before embarking
		Access control type	Fare collection at vehicle entrance causes time delay to embark Excludes some users due to complexity of operation
		Access control dimensions	Number of entrances to vehicle cause time delay to embark Height difference between platform and vehicle excludes some users Aperture dimensions excludes some users or causes physical discomfort

4.7 DATA COLLECTION INSTRUMENT

The entries in the criteria column of Table 4.3, shown above, were adapted to suit the data gathering process by allowing for individual descriptions of accessibility and wayfinding obstacles associated with each transport service and the connection, or concourse, linking these services. Visual data and observations at the case study sites described the user experience in this manner, while on- and off-site interviews with staff, documentation and the websites of the various institutions that managed the transport facilities and services provided input on the institutional structure and detailed the operations of the transport services. The data collection instrument is presented on the following pages.

Query	Evaluation	Information	Response
GENERAL			
Name	Name of interchange	Photo	
Locality	Name of municipality, suburb, zone	Maps	
Date of site visit	YYYY-MM-DD	Note	
Spatial layout	Layout of PTX	Plans, sketches, aerial	
Surface area	Approximate area under management	Plans, measurement	
Interchange passenger volume	Passenger count using PTX, time period used	Interview, website	
LAND USE			
Urban density around PTX	High, medium, low density	Photo	
Predominant land use around PTX	Residential, commercial, industrial, mixed	Photo	
MANAGEMENT			
Who manages the urban public transport system?	Per mode or integrated at local, provincial or national level, other	Interview	
Who manages the public transport interchange?	Per mode or integrated at local, provincial or national level, other	Interview	
Who manages the individual transport services?	Per mode or integrated at local, provincial or national level, other	Interview	
Between which modes is there fare integration?	Modes	Interview	
How are fares integrated?	Discounted, smartcard, free transfer with no access control		
Is there a management facility at the PTX?	Per mode, shared between modes	Photo, interview	
PLATFORM: PUBLIC TRANSPORT SERVICE A			
OPERATIONS			
Service type	Trunk, feeder, unclear	Interview	
Service mode	Heavy / light rail, underground rail, bus, minibus, BRT, other	Photo	
Service passenger volume using platform	Passenger count using mode, time period used	Interview	
Service managing agency	Per mode or integrated at local, provincial or national level, other	Interview	
Service operator	Public or private operator	Interview	
Service schedule	Scheduled, unscheduled	Timetable	
Service vehicle capacity	Number of passengers per vehicle / vehicle set	Interview	
Service fare type	Cash, paper voucher, magnetic strip voucher, smart card	Voucher, photo	
Service fare value	Fare value (or range of values) for a single trip	Fare table, photo	
Service fare units available	Multiple trip vouchers, integration with other services & value	Voucher, photo	
Type of fare sales device	Manual, self-service machine, other	Photo	
Method of payment accepted	Cash, credit card, other	Photo	
What is the nature of the management facility?	Office or kiosk for PT services, traffic, security, CCTV	Photo, interview	
What type of facilities are there for PTX staff?	Offices, refectory, common room, toilets, storage	Interview	
What type of security devices are used?	Guards, CCTV, automated entrance devices	Photo	
ACCESSIBILITY			
What access control is there at the platform exit / entrance?	Turnstiles, gate, manual collection, none, other	Photo	
What is the access control device dimensions?	Actual dimensions	Measurement, photo	
Can all users negotiate all parts of the platform?	Type of physical obstacle, user excluded	Photo	
Is the platform secured?	Closed system, open system	Photo	
What is the vehicle doorway dimensions?	Actual dimensions	Measurement, photo	
Can all users negotiate the doorway?	Yes, no, type of user excluded	Photo	

Does boarding occur at grade?	Yes, no	Photo
What is the nature of the platform?	Covered, surfaced, flat, other	Photo
What size is the platform?	Actual dimensions	Photo, sketch
What type of waiting facilities are there for users?	Seating, shelters, none, other	Photo
What type of commercial activity is there?	Formal, informal, shops, vendors	Photo
Are the commercial activities linked to user flows?	Relative location of commerce to PTX usage	Photo, sketch
What type of amenities are there?	Toilets, telephones, fare purchasing, banking, litter bins, water	Photo
Do amenities or trade obstruct a direct travel path?	Type of amenity	Photo
INFORMATION		
Is the name of the interchange or location apparent?	Yes, no	Photo
Is there information about adjacent destinations?	Yes, no	Photo
Is there information on the spatial layout of the PTX?	Yes, no	Photo
For which modes are there service information?	Trunk, feeder, none	Photo
For which modes are there route information?	Trunk, feeder, none	Photo
Is the arrival/departure time of the next vehicle indicated?	Yes, no, realtime	Photo
Are the exits from the platform apparent?	Yes, no	Photo
Is there tourist information available?	Information kiosk, maps, interactive displays, other	Photo, interview
Is there information about the whole public transport system?	Information kiosk, internet, maps, other	Photo, interview
Are there audio announcements?	Specify type of announcements	Listen, speakers
Is the current time displayed?	Clocks, other types of displays	Photo
PLATFORM: PUBLIC TRANSPORT SERVICE B		
OPERATIONS		
Service type	Trunk, feeder, unclear	Interview
Service mode	Heavy / light rail, underground rail, bus, minibus, BRT, other	Photo
Service passenger volume using platform	Passenger count using mode, time period used	Interview
Service managing agency	Per mode or integrated at local, provincial or national level, other	Interview
Service operator	Public or private operator	Interview
Service schedule	Scheduled, unscheduled	Timetable
Service vehicle capacity	Number of passengers per vehicle / vehicle set	Interview
Service fare type	Cash, paper voucher, magnetic strip voucher, smart card	Voucher, photo
Service fare value	Fare value (or range of values) for a single trip	Fare table, photo
Service fare units available	Multiple trip vouchers, integration with other services & value	Voucher, photo
Type of fare sales device	Manual, self-service machine, other	Photo
Method of payment accepted	Cash, credit card, other	Photo
What is the nature of the management facility?	Office or kiosk for PT services, traffic, security, CCTV	Photo, interview
What type of facilities are there for PTX staff?	Offices, refectory, common room, toilets, storage	Interview
What type of security devices are used?	Guards, CCTV, automated entrance devices	Photo
ACCESSIBILITY		
What access control is there at the platform exit / entrance?	Turnstiles, gate, manual collection, none, other	Photo
What is the access control device dimensions?	Actual dimensions	Measurement, photo
Can all users negotiate all parts of the platform?	Type of physical obstacle, user excluded	Photo
Is the platform secured?	Closed system, open system	Photo

What is the vehicle doorway dimensions?	Actual dimensions	Measurement, photo	
Can all users negotiate the doorway?	Yes, no, type of user excluded	Photo	
Does boarding occur at grade?	Yes, no	Photo	
What is the nature of the platform?	Covered, surfaced, flat, other	Photo	
What size is the platform?	Actual dimensions	Photo, sketch	
What type of waiting facilities are there for users?	Seating, shelters, none, other	Photo	
What type of commercial activity is there?	Formal, informal, shops, vendors	Photo	
Are the commercial activities linked to user flows?	Relative location of commerce to PTX usage	Photo, sketch	
What type of amenities are there?	Toilets, telephones, fare purchasing, panning, litter bins, water	Photo	
Do amenities or trade obstruct a direct travel path?	Type of amenity	Photo	
INFORMATION			
Is the name of the interchange or location apparent?	Yes, no	Photo	
Is there information about adjacent destinations?	Yes, no	Photo	
Is there information on the spatial layout of the PTX?	Yes, no	Photo	
For which modes are there service information?	Trunk, feeder, none	Photo	
For which modes are there route information?	Trunk, feeder, none	Photo	
Is the arrival/departure time of the next vehicle indicated?	Yes, no, realtime	Photo	
Are the exits from the platform apparent?	Yes, no	Photo	
Is there tourist information available?	Information kiosk, maps, interactive displays, other	Photo, interview	
Is there information about the whole public transport system?	Information kiosk, Internet, maps, other	Photo, interview	
Are there audio announcements?	Specify type of announcements	Listen, speakers	
Is the current time displayed?	Clocks, other types of displays	Photo	
PLATFORM: PUBLIC TRANSPORT SERVICE C			
OPERATIONS			
Service type	Trunk, feeder, unclear	Interview	
Service mode	Heavy / light rail, underground rail, bus, minibus, BRT, other	Photo	
Service passenger volume using platform	Passenger count using mode, time period used	Interview	
Service managing agency	Per mode or integrated at local, provincial or national level, other	Interview	
Service operator	Public or private operator	Interview	
Service schedule	Scheduled, unscheduled	Timetable	
Service vehicle capacity	Number of passengers per vehicle / vehicle set	Interview	
Service fare type	Cash, paper voucher, magnetic strip voucher, smart card	Voucher, photo	
Service fare value	Fare value (or range of values) for a single trip	Fare table, photo	
Service fare units available	Multiple trip vouchers, integration with other services & value	Voucher, photo	
Type of fare sales device	Manual, self-service machine, other	Photo	
Method of payment accepted	Cash, credit card, other	Photo	
What is the nature of the management facility?	Office or kiosk for PT services, traffic, security, CCTV	Photo, interview	
What type of facilities are there for PTX staff?	Offices, refectory, common room, toilets, storage	Interview	
What type of security devices are used?	Guards, CCTV, automated entrance devices	Photo	
ACCESSIBILITY			
What access control is there at the platform exit / entrance?	Turnstiles, gate, manual collection, none, other	Photo	
What is the access control device dimensions?	Actual dimensions	Measurement, photo	

Can all users negotiate all parts of the platform?	Type of physical obstacle, user excluded	Photo
Is the platform secured?	Closed system, open system	Photo
What is the vehicle doorway dimensions?	Actual dimensions	Measurement, photo
Can all users negotiate the doorway?	Yes, no, type of user excluded	Photo
Does boarding occur at grade?	Yes, no	Photo
What is the nature of the platform?	Covered, surfaced, flat, other	Photo
What size is the platform?	Actual dimensions	Photo, sketch
What type of waiting facilities are there for users?	Seating, shelters, none, other	Photo
What type of commercial activity is there?	Formal, informal, shops, vendors	Photo
Are the commercial activities linked to user flows?	Relative location of commerce to PTX usage	Photo, sketch
What type of amenities are there?	Toilets, telephones, fare purchasing, banking, litter bins, water	Photo
Do amenities or trade obstruct a direct travel path?	Type of amenity	Photo
INFORMATION		
Is the name of the interchange or location apparent?	Yes, no	Photo
Is there information about adjacent destinations?	Yes, no	Photo
Is there information on the spatial layout of the PTX?	Yes, no	Photo
For which modes are there service information?	Trunk, feeder, none	Photo
For which modes are there route information?	Trunk, feeder, none	Photo
Is the arrival/departure time of the next vehicle indicated?	Yes, no, real-time	Photo
Are the exits from the platform apparent?	Yes, no	Photo
Is there tourist information available?	Information kiosk, maps, interactive displays, other	Photo, interview
Is there information about the whole public transport system?	Information kiosk, internet, maps, other	Photo, interview
Are there audio announcements?	Specify type of announcements	Listen, speakers
Is the current time displayed?	Clocks, other types of displays	Photo
OTHER FEEDER SERVICES		
FIRST FEEDER TRANSPORT SERVICE		
Feeder private mode	Private car, taxi, bicycle, walking, other	Photo
Feeder service managing agency	Per mode or integrated at local, provincial or national level, other	Interview
Feeder service operator	Public or private operator	Interview
Feeder service storage	Vehicle parking, vehicle lockers, vehicle rank	Photo
SECOND FEEDER TRANSPORT SERVICE		
Feeder private mode	Private car, taxi, bicycle, walking, other	Photo
Feeder service managing agency	Per mode or integrated at local, provincial or national level, other	Interview
Feeder service operator	Public or private operator	Interview
Feeder service storage	Vehicle parking, vehicle lockers, vehicle rank	Photo
THIRD FEEDER TRANSPORT SERVICE		
Feeder private mode	Private car, taxi, bicycle, walking, other	Photo
Feeder service managing agency	Per mode or integrated at local, provincial or national level, other	Interview
Feeder service operator	Public or private operator	Interview
Feeder service storage	Vehicle parking, vehicle lockers, vehicle rank	Photo
FOURTH FEEDER TRANSPORT SERVICE		
Feeder private mode	Private car, taxi, bicycle, walking, other	Photo

Feeder service managing agency	Per mode or integrated at local, provincial or national level, other	Interview
Feeder service operator	Public or private operator	Interview
Feeder service storage	Vehicle parking, vehicle lockers, vehicle rank	Photo
CONCOURSE		
What type of concourse?	Formal (planned), informal (unplanned)	Photo
What is the nature of the concourse?	Covered, surfaced, flat, other	Photo
What size is the concourse?	Actual dimensions	Photo, sketch
What type of waiting facilities are there for users?	Seating, shelters, none, other	Photo
What type of commercial activity is there?	Formal, informal, shops, vendors	Photo
What type of amenities are there?	Toilets, telephones, fare purchasing, banking, litter bins, water	Photo
Do amenities or trade obstruct a direct travel path?	Type of amenity constructing	Photo
Is the name of the interchange or location apparent?	Yes, no	Photo
Is there information about adjacent destinations?	Yes, no	Photo
Is there information on the spatial layout of the PTX?	Yes, no	Photo
For which modes are there service information?	Trunk, feeder, none	Photo
For which modes are there route information?	Trunk, feeder, none	Photo
Is the arrival/departure time of the next vehicle indicated?	Yes, no, realtime	Photo
Are the exits from the concourse apparent?	Yes, no	Photo
What access control is there at the concourse exit / entrance?	Turnstiles, manual collection, none, other	Photo
What is the access control device dimensions?	Actual dimensions	Measurement, photo
Can all users negotiate all parts of the concourse?	Type of physical obstacle, user excluded	Photo
Is the concourse open or closed?	Closed system, unsecured open system	Photo
Is the concourse secured?		
What type of security devices are used?	Guards, CCTV, automated entrance devices, wall / fence, lighting	Photo
NOTES		

4.8 CONCLUSION

The aim of this chapter was to develop a conceptual understanding of what interchange is when seen through the eyes of the person who wishes to transfer between two public transport services or vehicles at an interchange. In order to do this, this chapter investigated the characteristics of the types of users that utilise interchanges, the various functional components of interchanges, the transfer trip tasks, and the obstacles that all types of users encounter while moving through and between each of these components. Once these concepts were investigated, and the criteria emerging from that investigation outlined, it was possible to develop a data collection tool that could document the user transfer experience as it actually occurs at interchanges, regardless of context, and allow for a comparison of the findings between all the sites. This allowed for the completion of the empirical research component of this project, i.e. case studies at interchanges in Cape Town, Sao Paulo and Curitiba. The individual and collective case study findings are presented in the next chapter.

5. INTERCHANGE CASE STUDY FINDINGS

5.1 INTRODUCTION

This chapter presents the findings of the empirical research process that was undertaken as part of the study, that is, the findings at the case study sites. The previous chapter described the interchange process as seen from the point of the view of the interchange user. In that chapter, it emerged that there were a number of obstacles that a user faces during the act of interchange. These obstacles informed the development of an instrument that would allow for the collection of data on the actual user transfer experience during interchange. The instrument was presented at the end of that chapter. In this chapter, the results of the application of the data collection instrument at the selected interchange study sites in Cape Town, Sao Paulo and Curitiba are summarised. In each of the cities three sites were documented that complied with the criteria that were outlined at the outset of the project. That is, they had to be urban public transport interchanges where transfer occurred between trunk and feeder services. This would ensure that a comparative evaluation could be made across sites and cities, responding to the third research question that asks whether interchange planning and design in Cape Town can be improved by looking at other comparable sites.

The first part of this chapter presents the findings per city, starting with Cape Town, then Sao Paulo and finally Curitiba. In the first instance, the respective localities, public transport networks and the typical vehicles in use on these networks are illustrated. The locations of the study sites are also shown on these maps. This is followed by a representation of the structure of the institutions that provide and operate the respective urban transport services and facilities. These institutions are identified by level, i.e. national, regional (province or state) or local, type (public, private or parastatal) and name. Thereafter follow the summarised findings at each study site, analysed according to the functional components of interchanges that were outlined in Chapter 4. Included in these summarised findings are layout plans for the respective interchanges at a consistent scale. The second part of this chapter presents the findings of the user transfer experience across all sites. The data are presented collectively in tables. This allows for comparative evaluations to be made of the user volumes, interchange dimensions, institutional structures, fare collection strategies and obstacles to successful user transfer not only between each transport service, but also between the different cities.

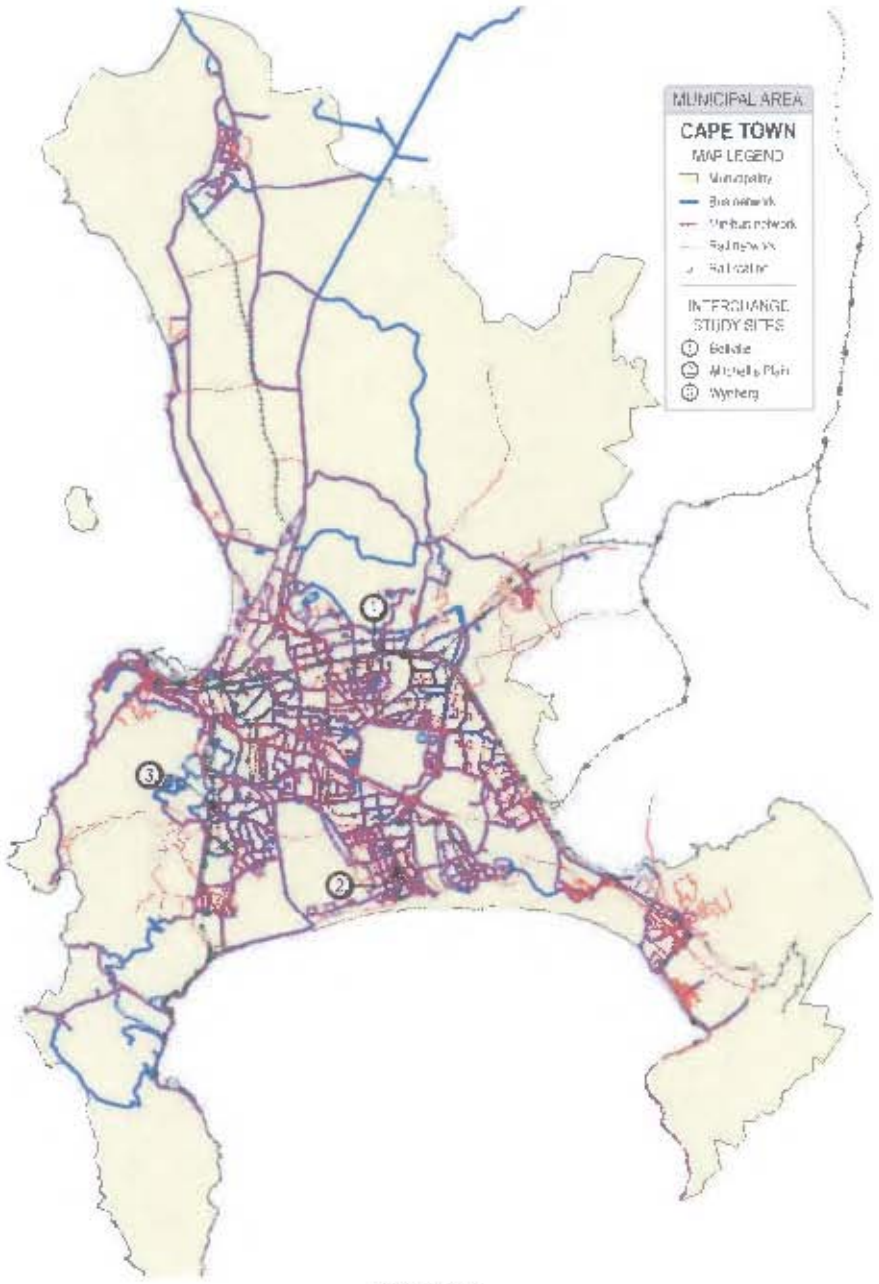
The chapter concludes with a summary of the main points that emerged from the findings. The complete findings for all sites, as captured with the data collection instrument, can be found at the end of this document in the Appendix.

5.2 CAPE TOWN PUBLIC TRANSPORT NETWORK AND SERVICES

Cape Town, the capital of the Western Cape Province, is a coastal city with a population of just over 3 million people. The metropolitan area is governed by one municipality, the City of Cape Town, and covers an area of 2847km² (CCT 2006d: 17). The city's locality can be seen in Figure 5.1, while Figure 5.2 indicates the municipal boundaries of the City of Cape Town, along with the primary public transport network layout and the locations of the interchange study sites.

(Base: Google Earth)

Figure 5.1: Cape Town locality



(CCT 2007a)

Figure 5.2: Cape Town municipal boundaries and transport network

5.2.1 Public Transport Services

The public transport network in Cape Town consisted of three main services. These services were scheduled bus, unscheduled minibus (also called minibus taxis) and scheduled overground rail. The route networks for these services are shown in Figure 5.3 to Figure 5.5 below, along with the locations of the study sites relative to those networks. Bus routes were predominantly long distance and widely distributed throughout the city. Minibuses performed a wide range of services that often competed with those offered by buses and rail, while also offering feeder services to rail. Rail was a highly commuter

oriented service, with certain lines extending beyond the municipal boundary. Except for the trunk rail service, it was difficult to classify bus and minibus services as either trunk or feeder as they were hybrid services that had not been planned to perform a specific structural function (CCT 2006d: 7-8; CCT 2007a: 34-43). Fares were charged individually per mode according to the trip length, and started at minimum of ZAR2,90, ZAR3,50 and ZAR 2,50 for bus, minibus and rail respectively.

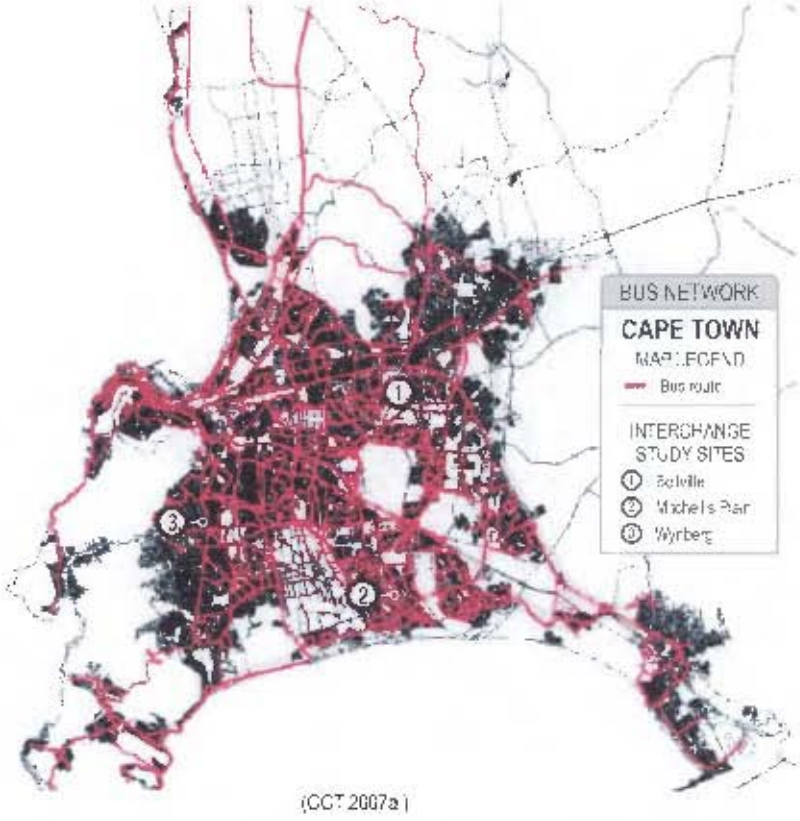
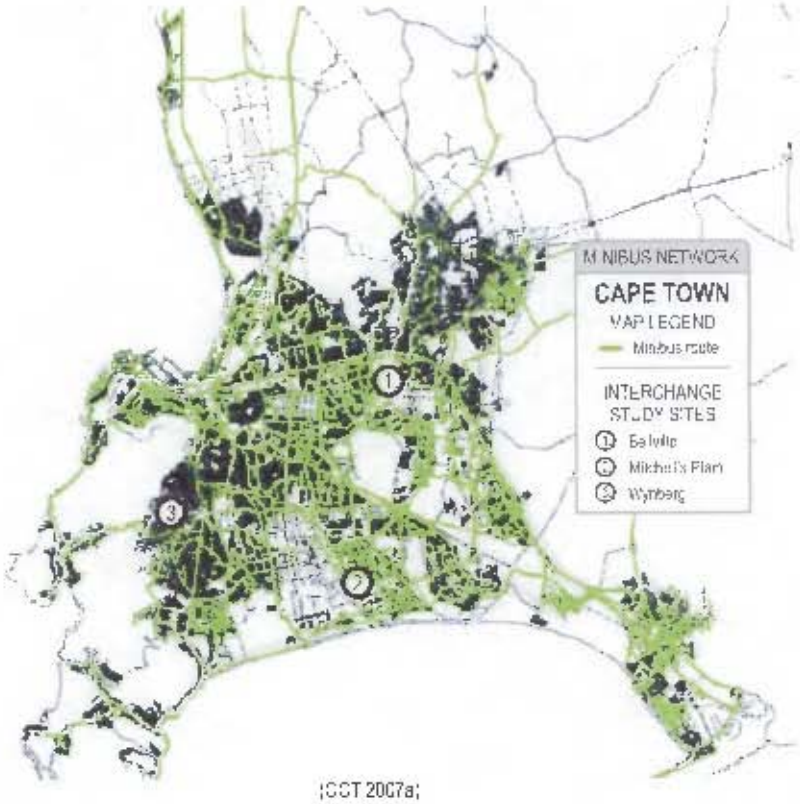
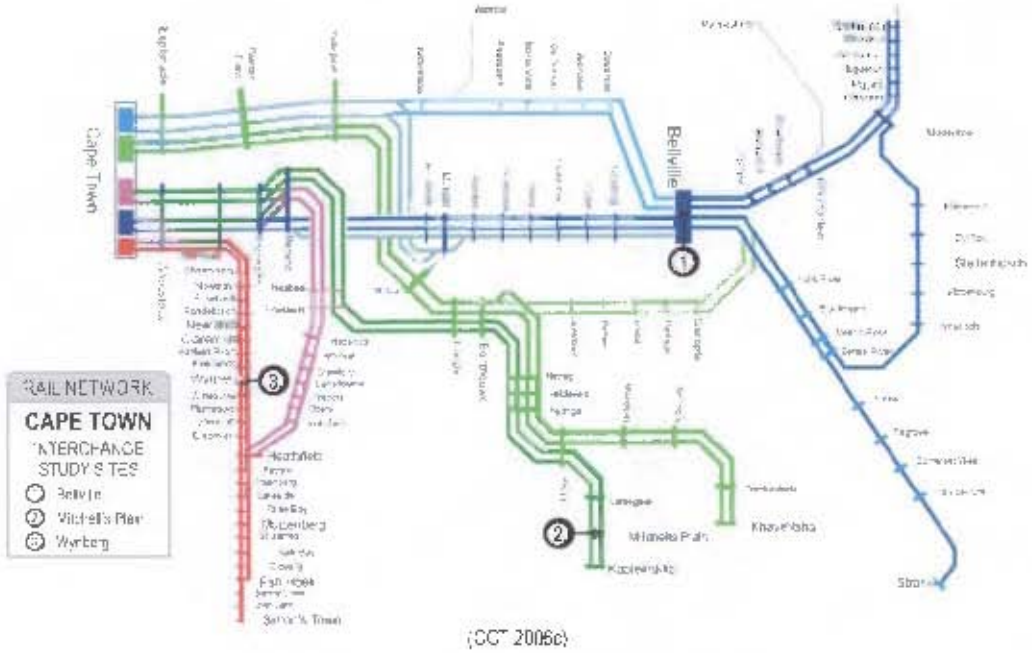


Figure 5.3: Cape Town bus service network



(CCT 2007a)

Figure 5.4: Cape Town minibus service network



(CCT 2006c)

Figure 5.5: Cape Town rail service network

The typical vehicles that provided public transport services in Cape Town are shown in Figure 5.6. The buses that were encountered at the study sites were all of the same size, and had an official capacity of 65 passengers. Minibuses generally had a capacity of 15 seated passengers. With respect to rail, the numbers of carriages in a train set, and thus overall capacity, varied according to demand on the route. None of the vehicles encountered in Cape Town, either road- or rail-based, offered at-grade or unassisted access for wheelchair users, even in the case of new vehicles.

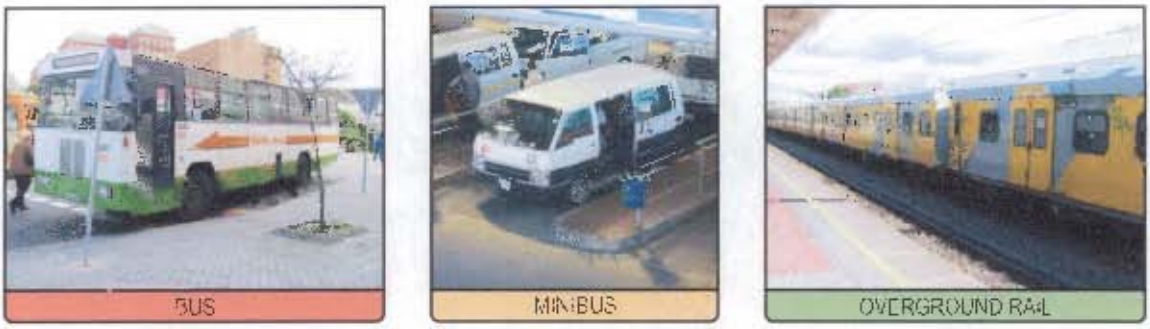


Figure 5.6: Cape Town public transport vehicles

5.2.2 Institutional Structure

Table 5.1 on the next page illustrates the structuring of the institutions governing the provision and operations of public transport services and facilities in Cape Town. The data in the table were collected from documentation (Behrens & Wilkinson 2002; CCT 2007b; Metrorail 2007; PGWC 2007). Even though the table lists a number of government institutions involved in the management of minibus operations, minibus services in practice were managed and controlled by private associations and/or individual operators. The national government admitted that it was in effect unregulated (RSA-NDT 2006a: 8-10). Furthermore, the documented interchanges each had a rank marshal on site representing and managing the relevant associations' interests at the minibus component of the interchange, over and above the management staff employed by the City of Cape Town at those sites. On the other hand, rail operations were fully owned and managed by the public sector since Metrorail, the operator, and the SARCC, the infrastructure owner, were both parastatal entities ultimately reporting to the National Department of Transport.

Table 5.1: Institutional structure of public transport provision in Cape Town

CAPE TOWN	BUS			MINIBUS			RAIL		
	LEVEL	TYPE	INSTITUTION	LEVEL	TYPE	INSTITUTION	LEVEL	TYPE	INSTITUTION
POLICY & REGULATION	National	Public	Republic of South Africa: Department of Transport	National	Public	Republic of South Africa Department of Transport	National	Public	Republic of South Africa: Department of Transport
	Provincial	Public	Provincial Government Western Cape: Department of Transport & Public Works	Provincial	Public	Provincial Government Western Cape: Department of Transport & Public Works			
	Local	Public	City of Cape Town: Department of Transport, Roads & Stormwater	Local	Public	City of Cape Town: Department of Transport, Roads & Stormwater			
MANAGEMENT & CONTROL	Province	Public	Provincial Government Western Cape: Department of Transport & Public Works	Local	Private	Minibus taxi associations / operators	National	Parastatal	South African Rail Commuter Corporation
SERVICE OPERATIONS	Province	Private	1 operator (Golden Arrow Bus Services)	Local	Private	Minibus taxi associations / operators	National	Parastatal	Metrorail (Western Cape division)
FACILITY OPERATIONS	Local	Public	City of Cape Town	Local	Public & Private	City of Cape Town & Minibus taxi associations	National	Parastatal	Metrorail (Western Cape division)

5.3 CAPE TOWN PUBLIC TRANSPORT INTERCHANGES

In Cape Town the Bellville, Mitchell's Plain and Wynberg public transport interchanges were documented. All three interchanges were served by bus, minibus and rail services. These public transport services, along with locations of the respective interchanges in the route networks, were outlined in the previous section. The following pages contain summaries of the accessibility and wayfinding aspects of the user transfer experience that emerged from the application of the data collection instrument for each interchange, along with layout plans outlining the relative position and size of the functional components which the user has to traverse during transfer. (The full findings can be found in the Appendix. It should be noted that official use of the term 'public transport interchange' by the City of Cape Town, as can be seen in signboards in some of the photographs, includes minibus and bus services, but not rail, and thus differs from the inclusive definition as used in this dissertation.)

CAPE TOWN
1. BELLVILLE

RAIL PLATFORM

- Single vehicle access, stepped and not at grade, fare collection on entry
- Open platform with no visible security or access control
- Rails guide queueing, provide perches, but restrict movement
- Vehicles do not cross platform boarding area
- Platform surface continuous with dropped kerbs to external access, full sheltering
- Platform toilets out of order, no seating provided
- Informal trade conflicts substantially with user movement
- Vehicles display destination above front window
- Location signs provided, but no locality information
- No platform layout map, exit signs, or route and schedule information (real time display out of order)
- No interchange layout map or directions to other service



MINIBUS PLATFORM

- Single vehicle access point, stepped and not at grade, fare collection cash only on entry
- Partially fenced platform with, no access control, guards visible
- Boarding areas very narrow
- Vehicles cross and block walkway that connects boarding areas, walkway raised throughout and continuous
- Platform surfacing continuous, partial sheltering
- No seating for waiting
- Some vending conflicts with user movement
- Most vehicles display destinations
- Location and locality information provided
- Service platform layout and directions provided, unscheduled service, no route information, exits not indicated
- No interchange layout map, some directions to other services



OVER/ROUND RAIL PLATFORM

- Multiple vehicle access points, not at grade, doors do not open automatically, frequently difficult to open manually
- Closed platform with access control at each boarding area, manual ticket fare collection, guards visible
- Large boarding areas separated by tracks
- Boarding areas connected by concourse subway, accessible only by staircases
- Surfacing continuous, waiting areas with seating and shelter
- No commercial activity on platform
- Vehicles display number, real time display at boarding area
- Location information provided, no locality
- No platform layout but directions and exits shown, schedule and route information provided
- No interchange layout map or directions to other services



INTERCHANGE CONCOURSE

- Rail to bus and minibus, rail subway linked by stairs to shopping mall, passing under road bridge, crosses over bus service lane
- Bus to minibus, cross bus service lane at road level, dropped kerbs provided
- Range of amenities along concourse, but commercial activity can conflict with user movement
- Substantial conflict with vehicles due to road level crossings
- Relatively long distance between rail and other services
- Surfacing discontinuous, interrupted by stairs and staircases, no alternatives to stairs, partial, discontinuous sheltering
- Some security guards visible
- Local on information only directly outside rail and minibus service
- No interchange layout map or continuous directions to services


CAPE TOWN
2. MITCHELL'S PLAIN

BTIS PLATFORM

- Single vehicle access: stepped and not at grade; fare collection on entry
- Open platform with visible guards and hidden cameras
- Rails guide queueing; provide perches, but restrict movement
- Vehicles cross platform boarding area; walkways at road level
- Platform surface continuous with concourse; full roofing
- No platform toilets; no seating provided
- No commercial activity visible on platform
- Vehicles display destination above front window
- No location or locality information visible from platforms
- Platform layout and destination information provided, but no exit signs, route or schedule information
- No interchange layout map or directions to other services provided



MINIBUS PLATFORM

- Single vehicle access point; stepped and not at grade; fare collection cash only on entry
- Two open platforms linked by new bridge over railway lines, one with guards and hidden cameras
- Boarding areas are narrow; railings provide perches
- Vehicles cross walkway that connects boarding areas; walkway raised throughout and continuous
- Platform surfacing continuous; full roofing; no seating for waiting
- Some vending conflicts with user movement
- Most vehicles display destinations
- Location and locality information visible at platform
- Service platform layout and directions visible; unscheduled service with no route information; exits not indicated
- No interchange layout map; some directions to other services



OVERGROUND RAIL PLATFORM

- Multiple vehicle access points; not at grade; doors do not open automatically; frequently difficult to open manually
- Closed platform with manual ticket fare collection before platform; narrow turnstile access control; guards visible
- Large boarding areas; separated by tracks
- Boarding areas connected by overpass; accessible only by staircases; elevators vandalised and out of order
- Surfacing continuous; waiting areas with seating and roofing
- No commercial activity on platform
- Vehicles display number only
- Location and locality information provided outside platform
- No platform layout, directions or exits shown; schedule and route information provided outside platform
- No interchange layout map or directions to other services

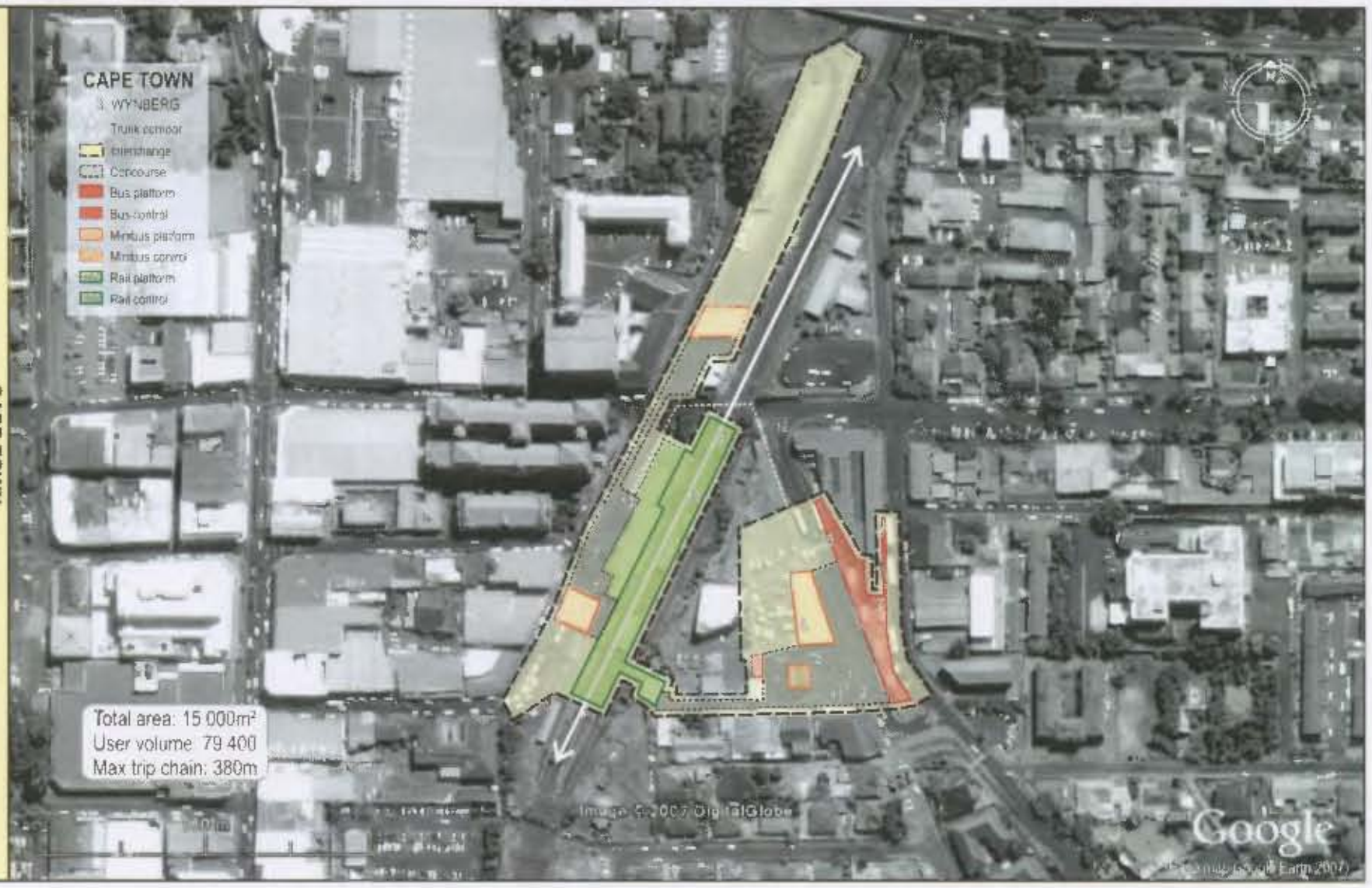


INTERCHANGE CONCOURSE

- Rail to bus and minibus: either through shopping mall and public square or new overpass
- Bus to minibus: cross minibus holding areas and minibus service lanes
- Minibus to minibus: cross new overpass
- Range of amenities along concourse, but commercial activity conflicts substantially with user movement at shopping mall
- Conflict with vehicles only between bus and minibus services
- Long distance between rail and other services
- Surfacing continuous; partial sheltering through shopping mall; new overpass entirely roofed
- Some security guards visible
- Location information only directly outside service platforms
- No interchange layout map or continuous directions to services



CAPE TOWN
3 WYNBERG



BUS PLATFORM

- Single vehicle access point, stepped and not at grade, fare collection on entry
- Open platform with visible guards
- Rails guide queueing, provide perches, but restrict movement
- Vehicles do no cross platform
- Platform surface continuous, roofing removed
- Toilets at minibus facility, some high level seating provided
- Formal commercial activity adjacent
- Vehicles display destination above front window
- No location or locality information visible from platforms
- No platform layout, destination or exit information, route and schedule information provides at minibus platform
- No interchange layout map or directions to other services provided

MINIBUS PLATFORM

- Single vehicle access point, stepped and not at grade, fare collection cash only on entry
- Three open platforms linked by narrow road and subway, all guarded
- Boarding areas very cramped, minimal high level seating
- Vehicles cross walkways that connect boarding areas, walkways continuous at one platform only
- Platform surfacing discontinuous, full roofing at each platform
- Informal commerce conflicts with user movement
- Most vehicles display destinations
- Location and locality information visible at two platforms
- Platform layout, directions and destinations visible at one platform, no route information, exits not indicated
- No interchange layout map, some directions to other services

OVERGROUND RAIL PLATFORM

- Multiple vehicle access points, not at grade, doors do not open automatically, frequently difficult to open manually
- Closed platform with manual ticket fare collection and access control before platform, guards visible
- Large boarding areas, separated by tracks, connected by subway accessible by staircases only
- Surfacing continuous, waiting areas with seating and roofing
- No commercial activity on platform
- Vehicles display number only
- Location and locality information provided outside platform
- No platform layout or directions, some exits shown, schedule and route information provided outside platform, new realtime display not yet operational
- No interchange layout map or directions to other services

INTERCHANGE CONCOURSE

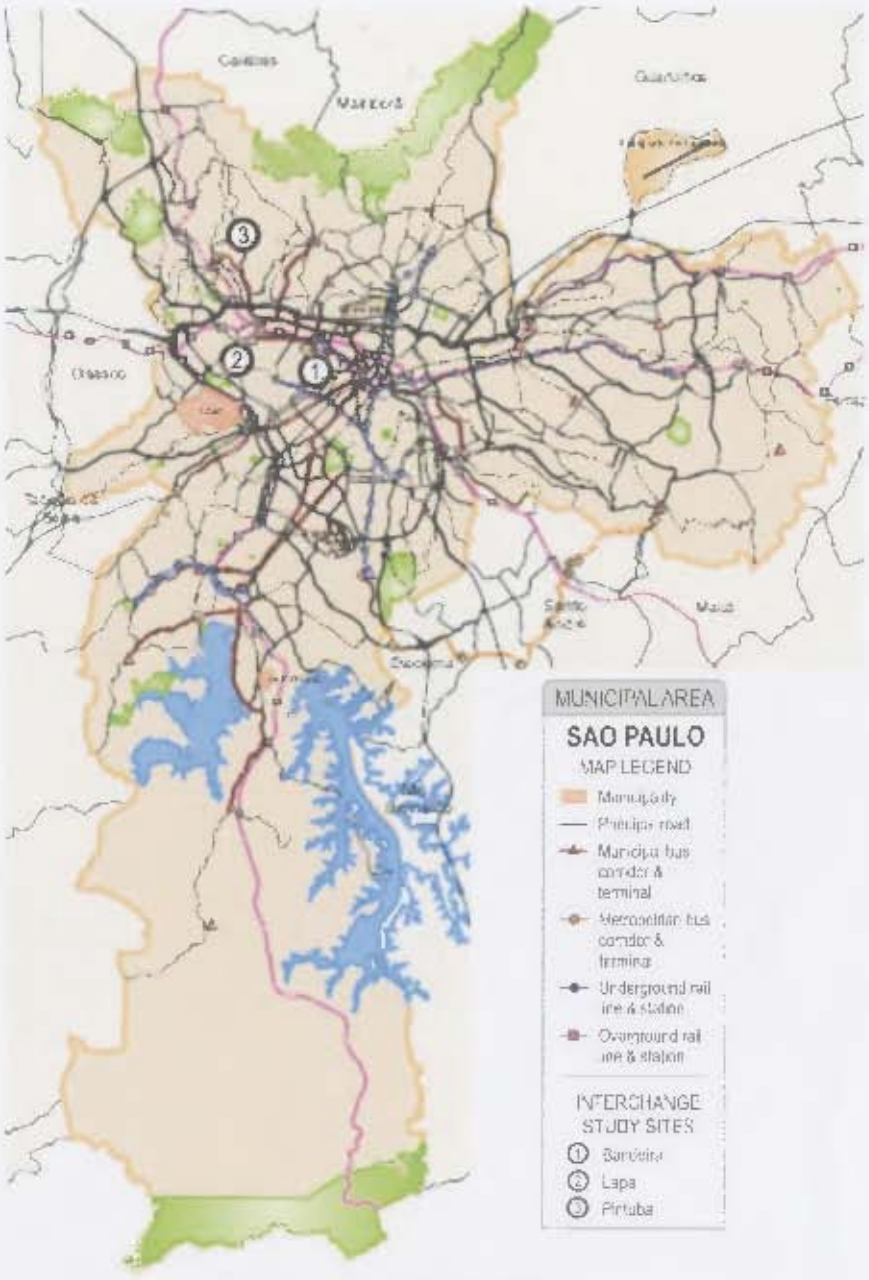
- The rail lines separate the eastern bus and minibus platforms from the two western minibus platforms. The only direct link between the two sides is a narrow road subway. The bus and minibus service roads have to be crossed on either side
- There is a range of amenities along concourse, but informal commercial activity conflicts substantially with user movement on the western side
- There is conflict with vehicles between all platforms
- Short to medium distance between transport services
- Surfacing is discontinuous with no roofing except in the subway
- Security guards are visible
- Location and locality information only visible outside eastern minibus platform, at western platform locality information only
- No interchange layout map or continuous directions to services

5.4 SAO PAULO PUBLIC TRANSPORT NETWORK AND SERVICES

The Sao Paulo metropolitan region, located in the State of Sao Paulo, had a population of 19 million people governed by 39 municipalities. The City of Sao Paulo was the municipality that sat at the heart of this agglomeration and also the state capital. It covered an area of 1509km², and was home to around 11 million people (CSP-MPS 2007). Figure 5.7 depicts the regional locality of Sao Paulo, which is about 70 km inland from the southeastern Brazilian coastline. The physical extent and primary transportation infrastructure of the City of Sao Paulo are shown in Figure 5.8.

(Base: Google Earth)

Figure 5.7: Sao Paulo locality



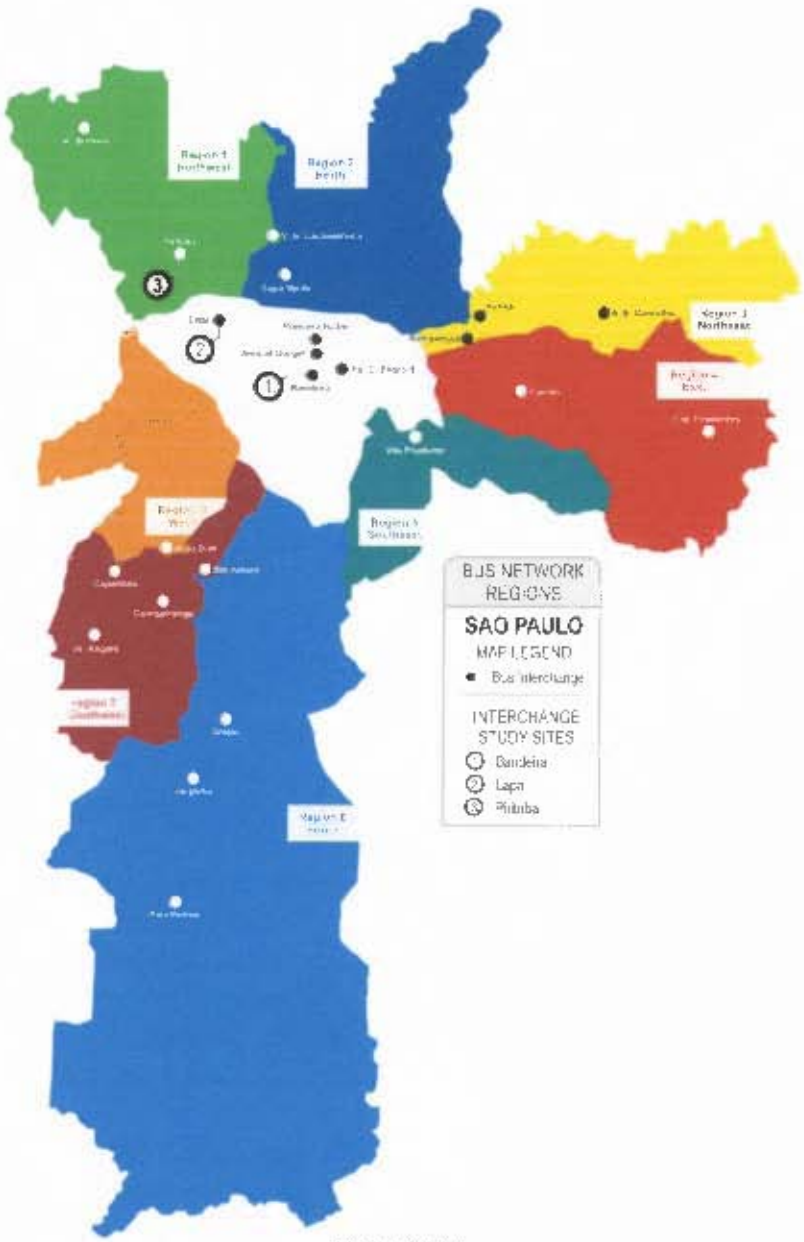
(CSP-MPS 2007)

Figure 5.8: Sao Paulo municipal boundaries and transport network

5.4.1 Public Transport Services

Sao Paulo was served by three public transport services: buses, overground rail and underground rail. The bus service comprised 588 trunk routes and 395 feeder routes (SPTrans 2007a, data for March 2007), managed by region. These regions, along with the feeder-trunk transfer terminals in each region, are shown in Figure 5.9. The other public transport services in Sao Paulo were rail based. Underground rail routes were more concentrated in the inner core of the city, while overground rail services ran further

away from the central area connecting more of the outlying municipalities. These services offered free transfers between them at a number of points. Figure 5.10 shows the respective routes and transfer points for these two services. Sao Paulo operated a flat fare system. Fares were BR$2,30 (or ZAR7,65 at March 2007 rates) across all modes.



(SPTrans 2007b)

Figure 5.9: Sao Paulo bus service regions

Figure 5.10: Sao Paulo overground and underground rail service network

The typical public transport vehicles that were encountered in Sao Paulo are shown in Figure 5.11. Buses ranged from 35-seater midi-buses to bi-articulated buses up to 27 metres in length. All new municipal buses were required to have a low boarding height that allowed for at-grade wheelchair access – as at March 2007 10% of buses offered this feature. Furthermore, all buses were uniformly branded and colour-coded according to the region of origin, i.e. the green bus depicted below operated to and from Bus Service Region 1, as indicated previously in Figure 5.9. With regards to rail, underground trains had 6 carriages each, with at-grade access. Overground rail carriages, on the other hand, ranged in capacity according to route and time of day and did not offer such accessibility.

Figure 5.11: Sao Paulo public transport vehicles

5.4.2 Institutional Structure

Table 5.2 on the next page present the structure of the institutions that governed the provision and operations of Sao Paulo's municipal public transport services and facilities. The data was gathered from documentation (CSP-TS 2007; FRB-TM 2007; Socicam 2007a; SPSG-MTS 2007; SPTrans 2007a). SPTrans, who managed and controlled municipal bus operations, were integrated in the City of Sao Paulo's Transport Secretariat. Similarly, the underground (Metro) and overground (CPTM) rail companies were parastatal entities controlled at state level by the State Metropolitan Transport Secretariat.

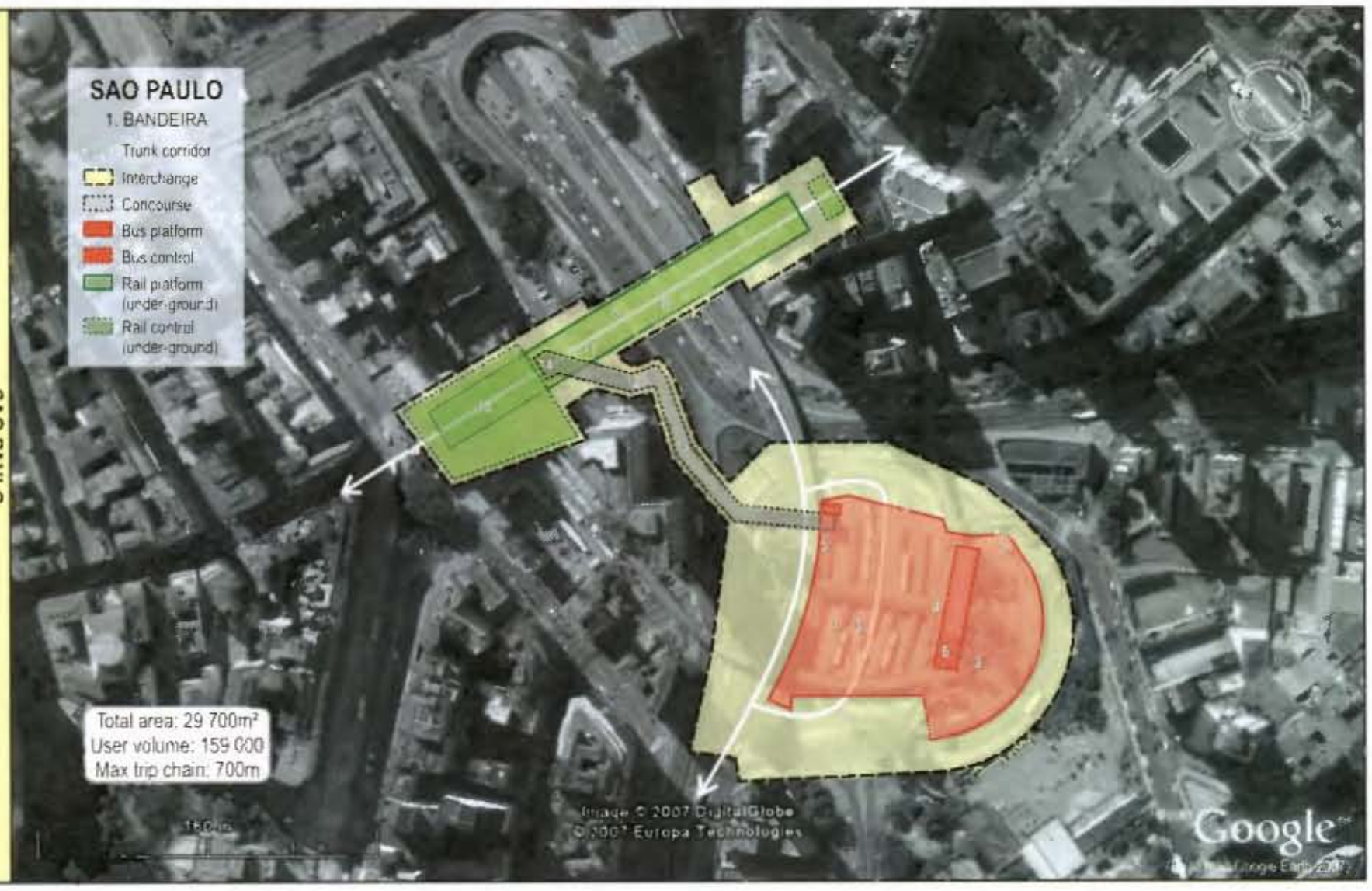
Table 5.2: Institutional structure of public transport provision in Sao Paulo

SAO PAULO	BUS			UNDERGROUND RAIL			OVERGROUND RAIL		
	LEVEL	TYPE	INSTITUTION	LEVEL	TYPE	INSTITUTION	LEVEL	TYPE	INSTITUTION
POLICY & REGULATION	National	Public	Federative Republic of Brazil: Transport Ministry	National	Public	Federative Republic of Brazil: Transport Ministry	National	Public	Federative Republic of Brazil: Transport Ministry
	State	Public	Sao Paulo State Government: Metropolitan Transport Secretariat	State	Public	Sao Paulo State Government: Metropolitan Transport Secretariat	State	Public	Sao Paulo State Government: Metropolitan Transport Secretariat
	Local	Public	City of Sao Paulo: Transport Secretariat						
MANAGEMENT & CONTROL	Local	Parastatal	Sao Paulo Transport (SPTrans)	State	Parastatal	The Metropolitan Company of Sao Paulo (Metro)	State	Parastatal	Sao Paulo State Metropolitan Train Company (CPTM)
SERVICE OPERATIONS	Local	Private	54 operators	State	Parastatal	The Metropolitan Company of Sao Paulo (Metro)	State	Parastatal	Sao Paulo State Metropolitan Train Company (CPTM)
FACILITY OPERATIONS	Local	Public	Sodicam	State	Parastatal	The Metropolitan Company of Sao Paulo (Metro)	State	Parastatal	Sao Paulo State Metropolitan Train Company (CPTM)

5.5 SAO PAULO PUBLIC TRANSPORT INTERCHANGES

Three interchanges were documented in Sao Paulo. These were the Bandeira interchange (comprised of the Bandeira trunk-feeder bus transfer terminal and the Anhangabau underground rail station), and two other interchanges, Lapa and Pirituba, which were served by overground rail, trunk bus and feeder bus services. The findings at each of these interchanges, describing in summarised format the accessibility and wayfinding findings at these three sites, are presented on the next pages. Layout plans of the interchange components of these sites, all to same scale, are included alongside the respective findings. As trunk and feeder buses shared the same platforms at all sites and utilised virtually identical vehicles, no distinction is made on the layout plans between these services (Full findings for all documented sites can be found in the Appendix.)

SAO PAULO
1. BANDEIRA



TRUNK BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Boarding areas sufficient in size, no seating provided
- Vehicles cross platform boarding area, walkways at road level
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout, direction and destination information and exit signs provided, route information from staff kiosks on platform
- Interchange layout map and directions to rail provided



FEEDER BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Boarding areas sufficient in size, no seating provided
- Vehicles cross platform boarding area, walkways at road level
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout, direction and destination information and exit signs provided, route information from staff kiosks on platform
- Interchange layout map and directions to rail provided


TRUNK UNDERGROUND RAIL PLATFORM

- Multiple vehicle access points at grade, small gap between vehicle and platform, doors open automatically with signal
- Closed platform with automatic ticket fare collection before platform, turnstile access control, visible guards and cameras
- Large boarding area with seating
- Boarding area and access control connected by staircases, escalators and elevators
- Surfacing continuous, fully sheltered and artificially ventilated
- Range of amenities between loading area and access control
- Vehicles display destination
- Location and locality information provided on platform
- Platform layout, directions and exits shown, route information provided
- Interchange layout map provided, no directions to bus service




INTERCHANGE CONCOURSE

- Bus trunk to feeder, fully integrated platform, no concourse
- Bus to under-ground rail, the concourse consists of a bridge over an arterial road and the crossing of a minor street outside the rail entrance
- Some amenities along concourse outside rail entrance, but limited to informal commercial activity, conflicts very little with user movement
- Conflict with vehicles only at minor street
- Medium distance between bus and rail
- Surfacing not continuous, bridge only accessible with escalator and staircases, street crossing doesn't have dropped kerbs
- Some security guards and hidden cameras
- Location information only directly outside service platforms
- No interchange layout map, but almost continuous directions



SAO PAULO
2. LAPA

TRUNK BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Large boarding areas, high kerb, seating provided
- Vehicles cross platform boarding area, raised walkway
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout, direction and destination information and exit signs provided, route information from staff kiosks on platform
- Interchange layout and directions to rail provided

FEEDER BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Large boarding areas, high kerb, seating provided
- Vehicles cross platform boarding area, raised walkway
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout, direction and destination information and exit signs provided, route information from staff kiosks on platform
- Interchange layout and directions to rail provided

TRUNK OVERGROUND RAIL PLATFORM

- Multiple vehicle access points not at grade, large gap between vehicle and platform, doors open automatically with signal
- Closed platform with automatic ticket fare collection before platform, turnstile access control, visible guards and cameras
- Large boarding area with seating
- Boarding areas connected by staircases only
- Surfacing continuous, fully roofed
- Range of amenities inside access control building
- Vehicles and platforms display destination
- Location and locality information provided on platform
- Platform directions and exits shown, route information provided
- Interchange layout map provided, directions to other transport service not provided

INTERCHANGE CONCOURSE

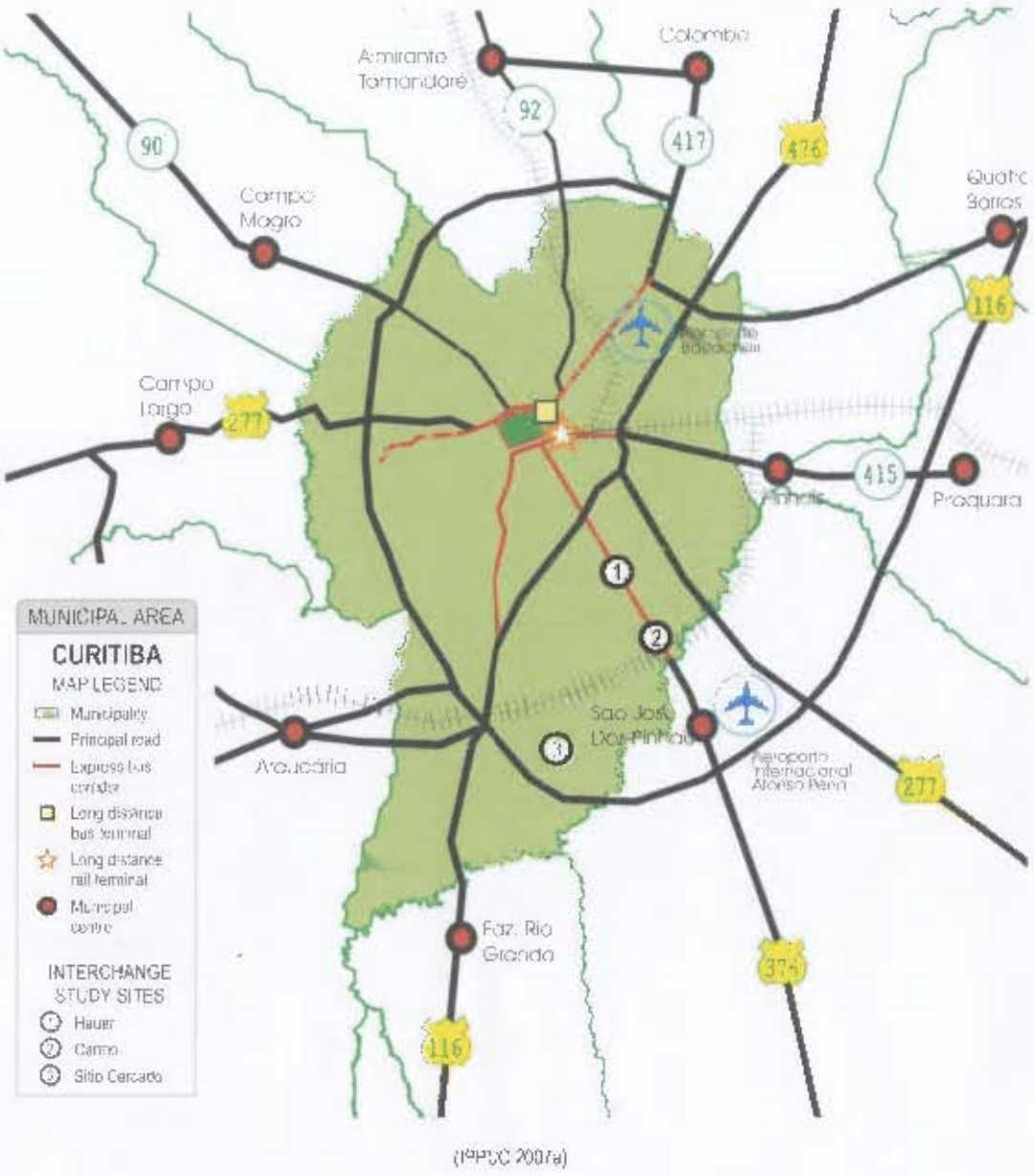
- Bus trunk to bus feeder: integrated services, no concourse
- Bus to rail: the concourse consists of a walkway connecting the two services on the one side, and a public square and a crossing of the bus service lane on the other
- Formal and informal commercial activity obscure the entrances to both service platforms, and conflict with user movement
- Conflict with vehicles at bus service lane
- Short distance between bus and rail
- Surfacing continuous, but road level crossing at bus service lane
- No security visible
- Location information visible outside both transport service platforms
- No interchange layout map or continuous directions between services

5.6 CURITIBA PUBLIC TRANSPORT NETWORK AND SERVICES

The metropolitan region of Curitiba, in the State of Parana, consists of 26 municipalities that had a total population of just under 2,8 million people in 2000, as recorded in the census of that year. Of this total, 1,6 million people lived in the City of Curitiba, which extends over 432 km². The city was the central municipality in the metropole as well as the state capital (IPPUC 2007a). It is about 600km southwest of Sao Paulo, as can be seen in Figure 5.12. The city, its neighbouring municipalities, and its primary transport network can be seen in Figure 5.13.

(Base: Google Earth)

Figure 5.12: Curitiba locality



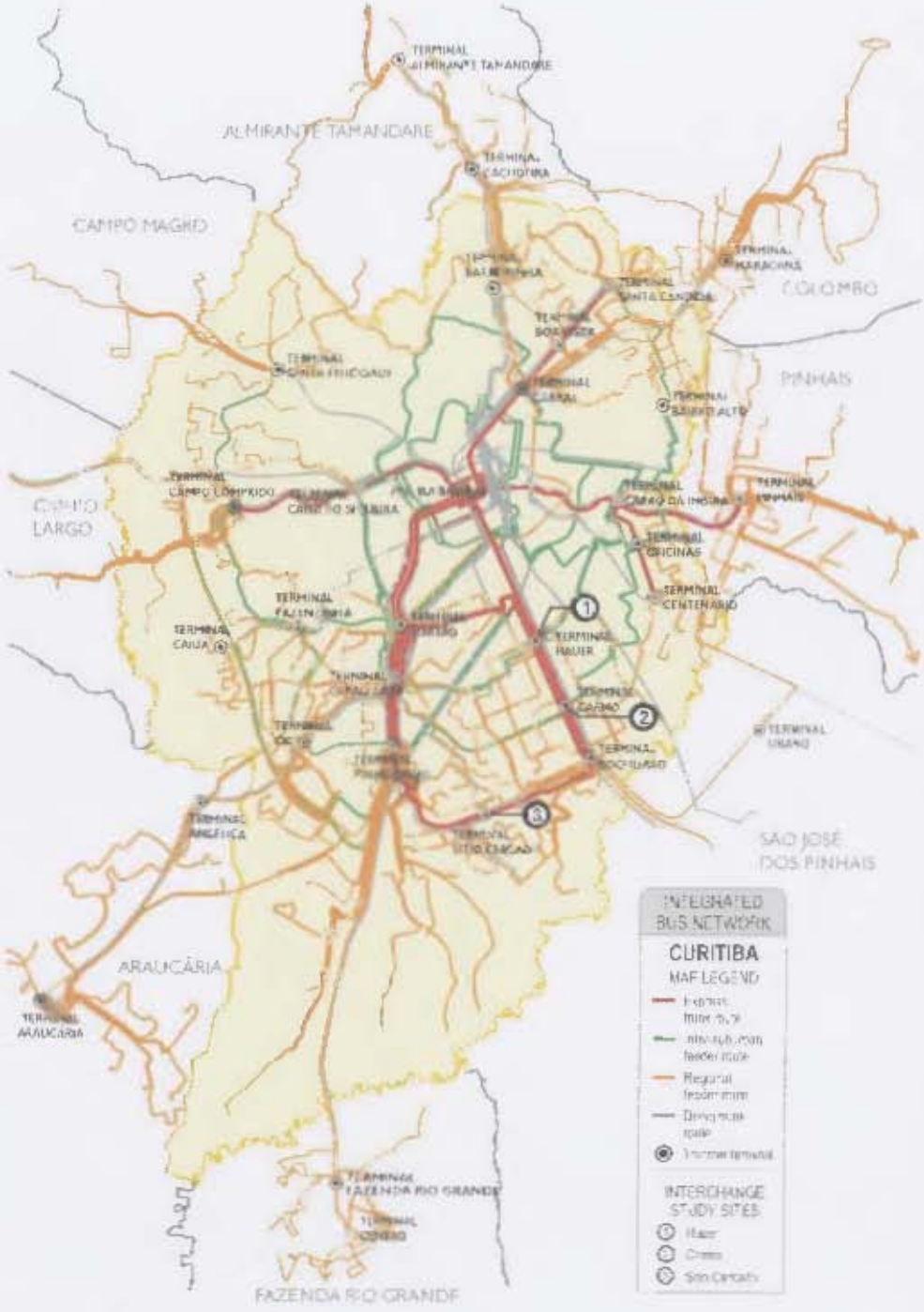
(IPPUC 2007a)

Figure 5.13: Curitiba municipal boundaries and transport network

5.6.1 Public Transport Services

The public transport services that were encountered at interchanges in the city were all bus-based. These bus services fell into two broad categories. Integrated services offered free transfers at interchanges ('transfer terminals'), while conventional bus services offered unintegrated coverage. Of the integrated services, express (red) and direct (silver-grey) lines offered trunk services, while regional feeder (orange) and municipal intersuburban (green) lines provided a distributive function to and from the trunk services (URBS 2003). The integrated bus network is shown in Figure 5.14. A general observation, there was one operational passenger rail line that terminated near the city

centre, but it offered only long distance services to outlying municipalities and the state coastline with no integration with the bus network interchanges. These services only charged a single flat fare BR$1,00 on Sundays, and BR$1,80 on all other days, equating to ZAR3,33 and ZAR6,00 at March 2007 levels.



(IPPUC 2007a)

Figure 5.14: Curitiba integrated bus service net work

5.7 CURITIBA PUBLIC TRANSPORT INTERCHANGES

The interchanges that were studied in Curitiba were at Hauer, Carmo and Sitio Cercado. All four integrated services – express, direct, intersuburban and feeder – were present at Hauer and Carmo, while Sitio Cercado only differed in this regard in that it was not served by intersuburban lines. The findings presented on the following pages summarise the functional layouts to scale, user accessibility and wayfinding elements encountered at each of these sites. In all instances, the express, suburban and feeder services shared the same platform, while direct services stopped at the tubular boarding platforms as indicated on the layout plans. (The full findings at the above sites can be found in the Appendix.)

SAO PAULO
3.PIRITUBA

TRUNK BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Large boarding areas: high kerb, seating provided
- Vehicles cross platform boarding area: raised walkway
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout and destination information, direction and exit signs provided, route information from staff kiosks on platform
- Interchange component layout and directions to rail provided

FEEDER BUS PLATFORM

- Multiple vehicle access points. 10% of city fleet provide at grade boarding at present, remainder stepped access not at grade
- Closed platform with access control and digital fare collection before entry, visible guards and cameras
- Large boarding areas: high kerb, seating provided
- Vehicles cross platform boarding area: raised walkway
- Platform surface continuous, full roofing
- Full range of amenities, do not conflict with user movement
- Vehicles display destination and basic route information on side, colour-coded to operational zone
- Location and locality information visible on platform
- Platform layout and destination information, direction and exit signs provided, route information from staff kiosks on platform
- Interchange component layout and directions to rail provided

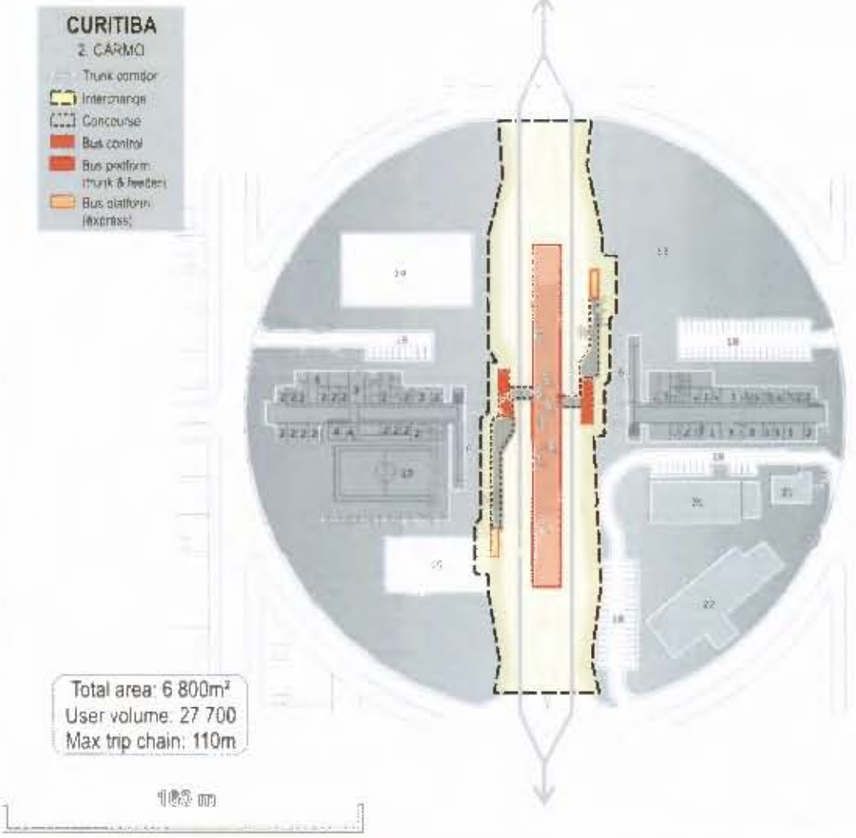
TRUNK OVERGROUND RAIL PLATFORM

- Multiple vehicle access points not at grade, large gap between vehicle and platform, doors open automatically with signal
- Closed platform with automatic ticket fare collection before platform, turnstile access control, visible guards and cameras
- Large boarding area with seating
- Boarding areas connected by staircases only
- Surfacing continuous, seating areas roofed
- Range of amenities inside access control building
- Vehicles and platforms display destination
- Location information provided on platform
- Platform directions and exits shown, route information provided
- No interchange layout map, directions to other services not provided

INTERCHANGE CONCOURSE

- Bus feeder to trunk, fully integrated platform, no concourse
- Bus to rail: the concourse consists of a road level crossing, a sidewalk passing under a road overpass and a staircase to the rail platform entrance
- There is only a small shop on the concourse, and the only amenity is a bicycle stand, no security visible
- Conflict with vehicles at the road crossing
- Medium distance between bus and rail
- Surfacing discontinuous, road level crossing does not have dropped kerbs
- Location information visible outside both transport service platforms
- No interchange layout map or continuous directions between services

CURITIBA
2. CARMO



TRUNK EXPRESS BUS PLATFORM

- Multiple vehicle access points, with at grade boarding
- Open platform with no security
- Large, raised boarding area, no seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full roofing
- Amenities provided, do not conflict with user movement
- Vehicles display destination and basic route information inside, colour-coded to function in transport network
- Location announced on vehicle, locality information on platform
- Platform directions and exits not clearly indicated, route information provided on platform
- No interchange layout map, some directions to other transport services

FEEDER BUS PLATFORM

- Multiple vehicle access points, boarding stepped and not at grade
- Open platform with no security
- Large boarding area, seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full roofing
- Amenities provided, do not conflict with user movement
- Vehicles display destination and basic route information on outside, colour-coded to function in transport network
- Location not clearly indicated, locality information on platform
- Platform directions and exits not clearly indicated; route information provided on platform
- No interchange layout map, some directions to other transport services

TRUNK DIRECT BUS PLATFORM

- Multiple vehicle access points, with at grade boarding
- Open platform with no security
- Large, raised boarding area, no seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full shelter
- No amenities provided
- Vehicles display destination above front window and colour-coded to function in transport network
- Location and locality information not indicated
- Route, destination and exit information displayed at platform, no layout or directions to amenities provided
- No interchange layout map or directions to other transport services

INTERCHANGE CONCOURSE

- Trunk bus to general bus, fully integrated main interchange platforms
- Express bus to trunk and general bus, raised sidewalk and road level crossing to main interchange platform, conflict with vehicles
- Surfacing continuous, level changes through dropped kerbs, no roofing over concourse
- Amenities include small shop, toilets and telephones, no informal commerce in interchange
- Amenities do not conflict with user movement
- The different services are located in close proximity
- The entire interchange is secured by a perimeter fence, staff surveillance and integrated access control
- No interchange layout map or continuous directions provided

CURITIBA
3. SITIO CERCADO

TRUNK EXPRESS BUS PLATFORM

- Multiple vehicle access points, with at grade boarding
- Open platform with no security
- Large, raised boarding area, no seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full roofing
- Amenities provided, do not conflict with user movement
- Vehicles display destination and basic route information inside, colour-coded to function in transport network
- Location announced on vehicle, locality information on platform
- Platform directions and exits not clearly indicated, route information provided on platform
- No interchange layout map, some directions to other transport services provided



FEEDER BUS PLATFORM

- Multiple vehicle access points, boarding stepped and not at grade
- Open platform with no security
- Large boarding area, seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full roofing
- Amenities provided, do not conflict with user movement
- Vehicles display destination and basic route information on outside colour-coded to function in transport network
- Location not clearly indicated, locality information on platform
- Platform directions and exits not clearly indicated, route information provided on platform
- No interchange layout map, some directions to other transport services provided



EXPRESS BUS PLATFORM

- Multiple vehicle access points, with at grade boarding
- Open platform with no security
- Large, raised boarding area, no seating provided
- Vehicles do not cross platform boarding area
- Platform surface continuous, full shelter
- No amenities provided
- Vehicles display destination above front window and colour-coded to function in transport network
- Location and locality information not indicated
- Route, destination and exit information displayed at platform, no layout or directions to amenities provided
- No interchange layout map or directions to other transport services provided



INTERCHANGE CONCOURSE

- Trunk bus to general bus, fully integrated main interchange platforms
- Express bus to trunk and general bus, raised sidewalk and road level crossing to main interchange platform
- Surfacing is continuous through use of dropped kerbs at level changes, concourse not roofed
- Amenities include small shop, toilets and telephones, no informal commerce in interchange
- Amenities do not conflict with user movement
- The different services are located in close proximity
- The entire interchange is secured by a perimeter fence, staff surveillance and integrated access control
- No interchange layout map or continuous directions provided



5.8 COMPARATIVE FINDINGS

The above section has provided a general background and summarised the individual site findings. The following section compares the findings across all the interchange study sites in Cape Town, Sao Paulo and Curitiba. As such, this section is a direct response to the third and last research question that aims to establish what lessons can be learnt from interchanges in other cities that could improve the user transfer process in Cape Town interchanges. This section presents comparative evaluations that link the level of integration between transport provision institutions and various interchange characteristics that influence the user transfer experience. The characteristics that were measured were the physical extents of interchanges, fare integration across services, the duplication of amenity facilities, effective accessibility provision, and lastly effective wayfinding provision.

Where such a link was found to be absent, as was the case with the latter two characteristics, accessibility and wayfinding, the absence could be explained by the fact that these characteristics were addressed at the design, and not system, level. Therefore, this section also provides insight in the connection between the focus of design guidelines in Cape Town, i.e. on vehicles, users or both, and the quality of the user transfer experience in this city. The measure of this connection lay in the presence or lack of effective accessibility and wayfinding management between and within the different components or interchanges.

The relevant institutional structures have been extracted from the previous section. The full range of institutional structures can be found under the data for each city in that section.

5.8.1 User volume, Surface Area and Transfer Distance

The physical dimensions of the user transfer experience that are presented here relate to the numbers of users utilising each respective interchange, the overall surface areas of the interchange and the distances that users have to travel between each platform. These data are shown below in Table 5.4.

The user volumes were the average total weekday number of passengers boarding and alighting at each interchange, and platform where available, over a whole day, rounded to the nearest 100 (CCT 2005a; CPTM 2007; IPPUC 2007a; Metro 2007; SPTrans 2007). The total interchange surface area was calculated by adding together the surface areas of the platforms, concourses, amenities, management facilities and vehicle holding areas, rounded off to the nearest 100 m^2 (Google Earth 2007; Socicam 2007b; URBS 2007). This area was presented visually on the layout maps of each site in the previous section of this chapter. The interchange area per user was calculated by dividing the overall interchange surface area by the total number of users at that particular interchange, and

rounded to two decimal spaces. Lastly, the maximum transfer distance is the longest possible distance that a user would have to travel within the boundaries of the interchange from the point of alighting from the vehicle of arrival to the point at which the user would access the onward vehicle, regardless of mode or platform. At Site 1 in Sao Paulo the underground rail boarding areas are two floors below ground level; thus, a transfer at that site is longer than is apparent from the plan layout shown in the previous section.

('CCT' = City of Cape Town; 'CPTM' = overground rail company of Sao Paulo)

Table 5.4: Comparison of user volumes, surface areas and transfer distances across study sites

AREA, VOLUME DISTANCE	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT. BUS
INSTITUTION	CCT	CCT	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	Local	National	Local	Regional	Regional	Local	Local	Local
USER VOLUME PER MODE									
SITE 1	11 400	48 100	61 600	96 000	63 000	-	N/A	N/A	N/A
SITE 2	20 400	61 100	19 700	60 000	-	16 500			
SITE 3	9 700	51 300	18 400	60 000	-	8 500			
USER VOLUME TOTAL	TOTAL			TOTAL			TOTAL		
SITE 1	121 100 / weekday			159 000 / weekday			68 100 / weekday		
SITE 2	101 200 / weekday			76 500 / weekday			27 700 / weekday		
SITE 3	79 400 / weekday			68 500 / weekday			47 000 / weekday		
INTERCHANGE AREA	TOTAL			TOTAL			TOTAL		
SITE 1	80 000m²			29 700m²			10 700m²		
SITE 2	76 100m²			18 300m²			6 800m²		
SITE 3	15 000m²			22 000m²			5 900m²		
INTERCHANGE AREA / USER	TOTAL			TOTAL			TOTAL		
SITE 1	0,66m² / user			0,19m² / user			0,16m² / user		
SITE 2	0,75m² / user			0,24m² / user			0,25m² / user		
SITE 3	0,19m² / user			0,32m² / user			0,13m² / user		
MAX. TRANSFER DISTANCE	FROM		TO	FROM		TO	FROM		TO
SITE 1	Bus >>	670m	<< Rail	Bus >>	700m	<< Undergr.	Direct >>	200m	<< Direct
SITE 2	Bus >>	595m	<< Rail	Bus >>	310m	<< Overgr.	Direct >>	110m	<< Direct
SITE 3	Minibus >>	380m	<< Bus	Bus >>	640m	<< Overgr.	Direct >>	165m	<< Direct

TABLE KEY	CAPE TOWN	SAO PAULO	CURITIBA
SITE 1	Bellville	Bandeira	Hauer
SITE 2	Mitchell's Plain	Lapa	Carmo
SITE 3	Wynberg	Pinheiros	Sitio Cercado

presence or absence of a fare collection system that allowed access to more than one transport service. The second measure was the cost involved in performing a transfer between transfer services. These data are presented in Table 5.5

(Abbreviations used in the table: 'PGWC' refers to Provincial Government: Western Cape; 'CSP' to City of Sao Paulo; and CPTM to the overground rail company of Sao Paulo)

Table 5.5: Comparison of fare integration across cities

FARE VOUCHER	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT. BUS
INSTITUTION	PGWC	Operators	Metrorail	CSP	CSP	CSP	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Regional	(Private)	National	Local	Local	Local	Local	Local	Local
COLLECTION SYSTEM	Bus-only vouchers	Cash	Rail-only vouchers	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card
COST OF TRANSFER									
INSTITUTION	CCT	Operators	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	(Private)	National	Local	Regional	Regional	Local	Local	Local
COST OF TRANSFER	Full fare	Full fare	Full fare	Half fare value	Free	Free	Free	Free	Free

As can be seen in the table, in the instances where the authority in charge of providing the particular fare voucher systems was the same across modes it led to the presence of an interoperable fare voucher system. In Sao Paulo and Curitiba, where this link between institutional and fare integration existed, the voucher system used was based on smart card technology. In Cape Town vouchers are provided only within the confines of the service, a fact which reflects the fragmentation of the institutions.

In terms of the cost of transfer, a similar link existed between institutional integration and on-the-ground operations. Where institutions were fully integrated, transfers between services occurred at no cost to the user. The opposite was also true, except for one variation in Sao Paulo: there existed a partial fare discount between the bus and rail services, yet the two rail operating authorities are integrated under the same regional government department, but the bus provision agency acted at the local. This can be explained by a comparison of the first and second parts of the table. In the first part, it is pointed out that the City of Sao Paulo established a single fare collection system, allowing the introduction of cross-modal functionality through all services. However bus services managed their own funds (and presumably profitability), as did the rail services, meaning that each service would want to collect fares from passengers on their respective

The table uncovers two factors that have a negative impact on the user transfer experience. Firstly, even though user volumes at the sites in Curitiba were not all of the same order as Cape Town or Sao Paulo, the ratios of interchange surface area to user volume allow for a comparative evaluation of the spatial efficiency at all the interchanges. These ratios were the highest in Cape Town, and much lower in Sao Paulo and Curitiba. This means that interchanges in Cape Town used larger plots of urban land to move the same number of users as in the other two cities, and consequently did so less efficiently. This was largely due to substantial provision for on site vehicle holding, i.e. temporary parking space for vehicles waiting to load passengers, in particular for minibuses. Vehicles parked at interchanges do not perform a transportation function at that time and, as the ratios show, lower the spatial efficiency of the interchanges. One exception is Wynberg, which had a ratio similar to sites in Sao Paulo and Curitiba. This could be explained by a severe lack of open land in and around the site, translating into less space available for vehicle holding, and thus better utilisation of space. Vehicle storage in Sao Paulo was limited to scheduling needs (i.e. early arrival or late departure), which translated into a maximum of two vehicles serving the same route at an interchange at any one time. This allocation was strictly applied by enforcement staff at the bus platforms, and adhered to by bus drivers.

Secondly, the table illustrates that due to the physical extent of interchanges and separate facilities for different modes in Cape Town (and to a lesser degree in Sao Paulo) the maximum transfer distance that a user had to negotiate between getting off the trunk service vehicle in which he or she arrived and boarding the onward feeder service vehicle, and vice versa, was substantial. It takes a number of minutes for any user, whether able bodied or not, to walk 450 metres between platforms (Cape Town's average distance), and certainly detracts from the transfer experience. The extent of the concourse, in such cases, is equally expansive. Another factor only affecting transfer distances in Sao Paulo was the additional vertical displacement necessitated by an underground rail platform.

The interchanges that fared the best in the above measures, those in Curitiba, had all services integrated and in close proximity, and were also the smallest in surface area, with no holding areas, yet still accommodated large numbers of users. The implication of this is that large vehicle storage areas, as found in Cape Town, and the non-integrated transport networks of Sao Paulo and Cape Town, increased the transfer distances.

5.8.2 Fare Integration

In order to illustrate the link between institutional integration and the existence of an integrated fare collection strategy, it was necessary to measure the level of such institutional integration against the level of fare integration on the ground. This measurement was done in two ways. Firstly, integration was measured in terms of the

presence or absence of a fare collection system that allowed access to more than one transport service. The second measure was the cost involved in performing a transfer between transfer services. These data are presented in Table 5.5

(Abbreviations used in the table: 'PGWC' refers to Provincial Government: Western Cape; 'CSP' to City of Sao Paulo; and CPTM to the overground rail company of Sao Paulo)

Table 5.5: Comparison of fare integration across cities

FARE VOUCHER	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT. BUS
INSTITUTION	PGWC	Operators	Metrorail	CSP	CSP	CSP	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Regional	(Private)	National	Local	Local	Local	Local	Local	Local
COLLECTION SYSTEM	Bus-only vouchers	Cash	Rail only vouchers	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card	Multimode smart card
COST OF TRANSFER									
INSTITUTION	CCT	Operators	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	(Private)	National	Local	Regional	Regional	Local	Local	Local
COST OF TRANSFER	Full fare	Full fare	Full fare	Half fare value	Free	Free	Free	Free	Free

As can be seen in the table, in the instances where the authority in charge of providing the particular fare voucher systems was the same across modes it led to the presence of an interoperable fare voucher system. In Sao Paulo and Curitiba, where this link between institutional and fare integration existed, the voucher system used was based on smart card technology. In Cape Town vouchers are provided only within the confines of the service, a fact which reflects the fragmentation of the institutions.

In terms of the cost of transfer, a similar link existed between institutional integration and on-the-ground operations. Where institutions were fully integrated, transfers between services occurred at no cost to the user. The opposite was also true, except for one variation in Sao Paulo: there existed a partial fare discount between the bus and rail services, yet the two rail operating authorities are integrated under the same regional government department, but the bus provision agency acted at the local. This can be explained by a comparison of the first and second parts of the table. In the first part, it is pointed out that the City of Sao Paulo established a single fare collection system, allowing the introduction of cross-modal functionality through all services. However bus services managed their own funds (and presumably profitability), as did the rail services, meaning that each service would want to collect fares from passengers on their respective

transport systems, regardless of origin before that point. This leads to the conclusion that the half-price transfer was negotiated as a compromise solution between the City of Sao Paulo, SPTrans, the Metro and CPTM.

Ultimately, the data in the table proves a clear link exists between the presence of institutional integration and the level of fare integration.

5.8.3 Shared Amenity Provision

Amenities on platforms and concourses such as telephones, fare purchase points, automated teller machines (ATMs) and snack sales add to the quality of the transfer experience by allowing the user to use transfer and waiting time more productively. In this section, the focus is on establishing the presence or absence of a link between the institutional integration and the sharing or internal provision of amenities at interchanges. Four indicators were selected and tested according to whether they were shared across platforms: toilet facilities, public telephones, fare purchase or recharge points, and commercial activities. The findings are presented in Table 5.6. It should be kept in mind that interchange between overground and underground rail facilities was not tested in Sao Paulo, and thus conclusions can only be drawn on the sharing of facilities between bus and either over- or underground rail.

(Abbreviations used in the table: CCT, or City of Cape Town; CPTM refers to the overground rail company of Sao Paulo)

Table 5.6: Comparison of shared provision of amenities across cities

AMENITY PROVISION	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT BUS
PROVIDED BY (INSTITUTION)	CCT	CCT	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	Local	National	Local	Regional	Regional	Local	Local	Local
TOILET FACILITIES	Shared	Shared	Internal	Internal	Internal	Internal	Shared	Shared	Shared
FARE PURCHASE POINT	Internal	-	Internal	Internal	Internal	Internal	Shared	Shared	Shared
PUBLIC TELEPHONES	Shared	Shared	Internal	Internal	Internal	Internal	Shared	Shared	Shared
COMMERCIAL AMENITIES	Shared	Shared	Internal	Internal	Internal	Internal	Shared	Shared	Shared

In Cape Town, the sharing of amenities existed only in some instances. Each rail platform had its own toilet facilities. However, bus and minibus platforms shared toilet facilities, direct access to public telephones and commercial activities in all three cases. Each platform had its own fare purchase booth, where such were applicable. The patterns of

sharing corresponded to shared responsibility at the local institutional level for public interchange provision and management.

Platforms in Sao Paulo did not share any facilities. All platforms had separate toilets, public telephones, smart card fare recharge points (both kiosks and machines), and commercial outlets. This reflected interchange provision institutions operating in isolation.

Interchanges in Curitiba offered nearly identical ranges of amenities. All amenities – toilet facilities, public telephones, fare purchase or recharge points, and commercial activities – were shared between platforms. There was also only one institution, URBS, in charge of interchange provision and management.

These indicators show that there appears to be a direct link between institutional integration at the local level across modes, and the shared provision of the amenities presented in the table

5.8.4 Accessibility

Accessibility throughout the user transfer trip chain, which is described in detail in Chapter 4, is affected by the detail design of each of the individual components of interchanges, as well as the design of the interfaces between those components. If, at any stage during the transfer, even only one of these components or interfaces does not offer continuous accessibility, it could mean that a transfer will not be able to be completed successfully. For example, if a wheelchair user has transferred successfully all the way from the service of origin to the boarding area of the destination service, but cannot get onto the onward vehicle because it does not offer at-grade boarding, then the entire trip chain is compromised. The trip chain is thus affected in equal measure by the boarding characteristics of vehicles, the interface between the vehicles and the platforms, the nature of the platform, the interface between the platform and the concourse, and the nature of the concourse. When the studied interchanges were analysed, certain patterns emerged in each city relating to accessibility of the interfaces and components.

The findings in Table 5.7, presented below, indicate the collective findings of these patterns per city, while detailed descriptions the findings at each site can be found in the first section of this chapter. The terms used in the table refer to the level of accessibility that a user experiences at the interface or component. Good accessibility means that all users should have been able to complete the portion of the transfer at the indicated stage. Fair accessibility implies that the needs of most users were addressed at that point, but that users might have been exposed to potential of conflict with vehicles or congested areas. Lastly, if only able bodied, adult, experienced users could perform a transfer, it is regarded as poor accessibility.

(Abbreviations used in the table: 'CCT' = City of Cape Town; 'CPTM' = overground rail company of Sao Paulo)

Table 5.7: Comparison of accessibility across cities

ACCESSIBILITY	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT. BUS
PROVIDED BY (INSTITUTION)	CCT	CCT	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	Local	National	Local	Regional	Regional	Local	Local	Local
VEHICLE – PLATFORM	Poor	Poor	Poor	Fair	Good	Poor	Good	Poor	Good
CROSS-PLATFORM	Fair	Fair	Poor	Fair	Good	Poor	Fair	Good	Good
PLATFORM – CONCOURSE	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
CROSS-CONCOURSE	Poor			Poor			Fair		

The table illustrates the poor standard of accessibility in the three cities. Even in Curitiba, which in relative terms offers the best transfer accessibility of all three cities, interchange accessibility still has a long way to go in order to offer a good quality transfer experience. The collective conclusion from these findings is thus that it is not the form of institutional structure that plays a direct role in the accessibility of the components of interchanges, but rather continuous attention to the design of the interchanges components and the interfaces between such components during each stage of the user transfer trip chain. The design of interchanges is governed by design and planning guideline documents. In the case of Cape Town, the poor level of design can be explained by the fact that these guideline documents, as reviewed in Chapter 3, are predominantly vehicle-focused, and do not give significant input on the design of complete transfer trips.

5.8.5 Wayfinding

In order to complete a transfer efficiently, a user should be able to find his or her way through an interchange from one service to the next without having to resort to consulting a fellow passenger or interchange staff member. There should be sufficient wayfinding aids, in the form of visual, audio and sensory aids, for a user to complete a transfer without such assistance. Such wayfinding devices at the selected interchanges were analysed according to a number of categories (detailed in Chapter 4). Location information related to the provision of signboards and announcement that indicated the interchange or location name, and outlined the layout of the various components of the interchange in relation to one another ('Where am I now? How do I get to Service B from here? Where is the exit?'). Locality information included the provision of maps and

directions to destinations in the vicinity of the interchange ('If I get off here, what can I do/see/visit in the area?'). The last category of wayfinding information that was assessed was route, schedule and fare information which gives the user an indication of what transport services operate from the interchange, where they go from there, at what time they arrive and depart, and what costs are involved. This type of information was collectively termed service information. The summarised findings for all the above catergories are shown in Table 5.8.

In terms of wayfinding, a good rating in the table means that all users would have been able to find their way to and from the indicated point. This is achieved only if comprehensive location, locality and service information, as applicable, was available. A fair rating signifies that some wayfinding aids were provided, but that these were not continuous along the transfer path, nor did they address all users in equal measure. Lastly poor wayfinding is indicated when very little information was provided, and the user thus had to be familiar with the interchange layout, or would have had to resort to consulting other users, or locating staff, to assist in completing the transfer trip.

(Abbreviations used in the table: 'CCT' is the City of Cape Town and 'CPTM' is the overground rail company of Sao Paulo)

Table 5.8: Comparison of wayfinding across cities

WAYFINDING	CAPE TOWN			SAO PAULO			CURITIBA		
MODE	BUS	MINIBUS	RAIL	BUS	UNDERGR. RAIL	OVERGR. RAIL	TRUNK BUS	FEEDER BUS	DIRECT. BUS
PROVIDED BY (INSTITUTION)	CCT	CCT	Metrorail	SPTrans	Metro	CPTM	URBS	URBS	URBS
LEVEL OF GOVERNMENT	Local	Local	National	Local	Regional	Regional	Local	Local	Local
VEHICLE – PLATFORM	Poor	Poor	Poor	Fair	Fair	Fair	Poor	Fair	Poor
CROSS-PLATFORM	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor
PLATFORM – CONCOURSE	Poor	Fair	Poor	Fair	Fair	Fair	Poor	Poor	Poor
CROSS-CONCOURSE		Poor			Poor			Poor	

There are two general observations on wayfinding concerning all cities. The first is that, since all text on signage in Sao Paulo and Curitiba was in Portuguese, navigation for an English-speaking tourist, for instance, would be near impossible. However, in Brazil the only official language is Portuguese and thus most users of local transport could be expected to have a sufficient grasp of the language. In Cape Town, on the other hand, English was in most cases the only language used in wayfinding and information provision, even though it is only one of 11 official languages in South Africa. It cannot be

assumed that even local users would be fluent in English. Pictograms and symbols, where they were or could be used lent themselves much more to universal understanding, and was a way in which, at least partially, the language problem could be overcome.

The second observation is that, on the whole, wayfinding in all cities required a user to be literate, visually able and familiar with the transport system and individual routes. There was not much scope for users deviating from this limited norm. Wayfinding devices aiding users with visual disabilities were very limited. The few instances of audio assistance that were recorded were location announcements on rail services in Sao Paulo and express bus services in Curitiba, and platform announcements of service changes in Sao Paulo and Cape Town. The only use of textures were the textured paving pattern indicating the boarding area edges of two of the bus platforms in Sao Paulo, and the texturing of some dropped kerb areas in Cape Town and Sao Paulo.

If the above observations between cities are compared to the level of integration at institutional level, there does not appear to be a direct link. Regardless of the level of integration, wayfinding provision remained poor. In fact, it appeared as if the range of results was relatively consistent within each service, implying that the individual institution's focus on wayfinding design is a common thread through all components under its control (i.e. excluding the concourse). The lack of information provision also occurs across all concourses, mirroring the lack of concourse and design (and management in the case of Cape Town and Sao Paulo). Since this type or design should be directed by design guideline documents, it supports the finding in Chapter 3 of this dissertation that the guidelines, as far as Cape Town is concerned, are modally oriented. Wayfinding problems will thus not be addressed successfully by institutional integration, but rather through the provision of effective design guidelines.

5.9 CONCLUSION

This chapter has given an overview of the user transfer experience at interchange sites in Cape Town, Sao Paulo and Curitiba, providing an insight into the user transfer process in practice. Besides presenting the functional components, detailed in Chapter 4, that were found at each of the interchange sites, and providing the summarised findings following from the application of the data collection instrument, this chapter also compared findings across all sites, modes and cities according to the respective institutional structures, fare collection characteristics, accessibility, wayfinding and amenities.

Based on the evidence presented in this chapter, it seems that there is very little holistic management of the transfer process between modes at any of the interchange sites. Even though there appeared to be a link between the level of integration between transport provision institutions and of integration between transport services at interchanges, such integration only had a demonstrable effect on improved fare collection

systems and more efficient land use. Institutional integration did not seem to be directly linked to the other important aspects of user transfer efficiency that were measured, i.e. accessibility and wayfinding. Rather, these aspects were influenced by the design of the interfaces between transport services, platforms and concourses. It is reasonable to assume that this level of detail should have been addressed by interchange design guidelines. However, as concluded in Chapter 3, the guidelines that were commonly used in South Africa appeared to be oriented towards the needs of public transport vehicles, and offered little input regarding the quality of the user experience during transfer. These conclusions are supported by the findings presented in this chapter: accessibility and wayfinding provisions for interchange users were of a poor standard. Furthermore, multiple conflict points between vehicles and users at boarding areas appeared to be inherent in the layout of interchange platforms. Thus, a clear discrepancy exists between the prescriptions of policy, on the one hand, which aim to improve the illustrated poor user experience and, on the other hand, the bias towards designing interchanges around the needs of vehicles and the associated lack of attention to the needs of users.

The next, and final, chapter concludes the research process by providing recommendations on how the user transfer experience can be improved against the background of the findings outlined in this chapter and suggests topics that warrant further research based on the findings of this dissertation.

6. CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

This final chapter of the dissertation provides an overview of the research argument and concludes that argument in view of the research questions, as set out at the beginning of the dissertation, that underpin the project. Also included in this chapter are recommendations aimed at addressing the problems that were identified in the literature review and empirical research, along with future research topics that relate to the findings and recommendations of this project.

6.2 OVERVIEW OF THE RESEARCH PROCESS AND FINDINGS

As stated in the first chapter of this dissertation, this research project was inspired by a concern based on informal observations at public transport interchanges: it appeared that interchanges were designed around the needs of the vehicles that utilised those facilities, and not the needs of the actual people who used the public transport services, resulting in a poor user transfer experience. In order to test the validity of this concern, research strategies for understanding the context of public transport interchanges, interchange users and the act of interchange were necessary. The findings of the dissertation that emerged from the execution of the research strategies, as detailed in Chapter 2, confirmed that interchange provision is mostly vehicle based, and that this indeed meant that the quality of user transfer was poor. As the investigations in this dissertation were based on three central research questions, the overview of the findings is presented here at the hand of these questions. The first question, outlined below, was answered by an investigation into the policy and guidelines surrounding public transport and interchange provision:

1. *What direction does the regulatory and planning environment give to the design and planning of public transport interchanges?*

Interchanges are public facilities. As such, the provision of existing interchanges would have been guided by public policy and guidelines. What direction did policy provide in terms of a specific role for interchanges in the public transport system and what was the focus of guidelines that transferred this role into practice? This question was addressed in Chapter 3 through a review of public policy and a number of guidelines that were concerned with the provision of public transport systems and public transport facilities.

In terms of policy, it was clear that transfers between services (particularly trunk and feeder services) were to be encouraged to promote efficiency in the system. This meant that interchanges played a central role in urban public transport systems. However, it was recognised that public transport systems and facilities were predominantly vehicle-oriented, and that the user should be prioritised in order to redress this imbalance.

Thus the focus of the review turned to the most recent guidelines for the planning and design of interchanges to see how the user would be prioritised, and to investigate the measures contributing towards making user transfers more efficient and convenient. However, it emerged that even the guidelines produced in the last five years were modally oriented. The reason for this was that the main contents of these guidelines were carried over without noticeable modifications from mode-specific guidelines developed in the 1980s. Very little guidance was given on how to manage and improve the user transfer experience between modes. If anything, the suggested vehicular layouts actually reinforced conflict between vehicles and users by necessitating users to cross the travel paths of vehicles. The guidelines clearly contradicted policy goals. Since the guidelines did not provide adequate guidance on the needs of users during transfers, the second research question was put forward:

2. *What is interchange when observed from the point of view of the user?*

In order to develop an in-depth understanding of user transfers, it was necessary to first identify the elements that affect the user experience during interchange. These elements were the characteristics of the types of users that utilise interchanges, the various functional components of interchanges, the transfer trip tasks, and the obstacles that all types of users encounter while moving over and between each of these components, and were described in Chapter 4.

The abilities of all users, be that physical, sensory, cognitive or financial, affected how they proceeded through an interchange when performing a transfer and what constituted and obstacle to them. When transferring, a user would disembark from a vehicle in a trunk or feeder public transport service onto that vehicle's platform, and then connect to another feeder or trunk service's platform from where the vehicle that goes to the onward destination could be boarded. The connecting area was described as a concourse – the link between different services' platforms. The transfer itself resembled a trip from one vehicle to another along which the user had to perform certain tasks, such as passing through access control and confirming whether he or she was at the correct platform. During this trip there could be various obstacles, such as the lack of a signboard showing where the next service departs from, or a gathering of vendors blocking the way to the exit. The former type of obstacle was termed a wayfinding obstacle, and the latter an accessibility obstacle.

Once an analytical framework, or data collection tool, describing the elements of the user transfer experience was developed at the end of Chapter 4, it was possible to collect data according to this framework at actual interchanges in order to gauge the user's experience during transfer in reality.

3. *What lessons for improving interchange design and planning in Cape Town can be learnt from comparable interchanges in other cities?*

The last question was answered by applying the data collection tool at interchange sites not only in Cape Town, but also in two Brazilian cities, Sao Paulo and Curitiba, in order to compare the findings across sites and cities to see whether foreign interchange practice could benefit Cape Town. Brazil, like South Africa, is a rapidly developing country presenting similar socioeconomic attributes and challenges, but with a much stronger public transport culture. The particular cities were selected because Sao Paulo had a similar modal mix to Cape Town and service extensions or modifications often had to be retrofitted into a complex existing urban fabric. Curitiba's transport system was in large part what the desired future system for Cape Town was based on, and it had a similar population size. The comparative findings, revealed in Chapter 5, brought to the fore a number of interesting results. Three particular points will be repeated here.

The first is that an integrated public transport provision body, as in Curitiba, does not guarantee high quality transfers within or between different services at interchanges. Physical accessibility and wayfinding aids were not of a very high standard either internally or between different services. The results in Sao Paulo and Curitiba rather seemed to indicate that better institutional integration only really affected the less tangible aspect of user transfers: the fare collection system. The implications for South Africa? The policy and guideline documents reviewed in Chapter 2 consistently call for integrated transport authorities to be instituted in urban regions in South Africa in order to improve the provision of public transport systems. In line with the findings of this research project, the existence of such a body does not necessarily lead to improvements in the physical quality of the public transport system or the overall user transfer experience. On the other hand, the continued isolated existence of institutions in Sao Paulo and Cape Town translated into the persistence of modally fragmented public transport systems. (In terms of the research activities, it was much easier to gain access to, and collect data at, the interchanges in Curitiba than in either Cape Town or Sao Paulo, as there was only one authority in charge of all operations – i.e. URBS.)

The second related point is that, in all cases, the concourses that linked the various transport services lacked sufficient accessibility and wayfinding management to accommodate the full range of users expected at interchanges. The public transport provision mindset that seems to favour designing facilities with vehicles as the primary design unit, and not the end users, was not limited to Cape Town. Users were forced by the layouts of all interchanges to cross vehicular travel ways at some stage during a transfer. This type of conflict was inherent in the designs of all the documented interchanges. If this continues to be the case, as it certainly seems to be if one also looks

at the current interchange planning and design guidelines reviewed in this project, it does not bode well for achieving the policy aims of putting the user first.

The last point that will be outlined here in regard to the research finding relates to the provision of commercial amenities at interchanges. While interchanges in Cape Town were by far the most expansive of all those investigated, this characteristic translated into increased opportunities for informal and formal trade along the transfer trip chains of users. These opportunities were certainly acted upon, so much so that during off-peak periods at Wynberg and Bellville there were probably more traders than transport users on the platforms and along the concourses of those interchanges. However, during peak times trading, especially of the informal type, could be a serious obstacle to efficient and rapid user transfer. In the end, there seems to be a trade-off between the user amenity value and the user 'obstacle' value of commerce at transport facilities. Whichever approach is favoured, it bears serious consideration given the socioeconomic realities in both countries.

6.3 RECOMMENDATIONS

Two themes run throughout the research endeavour: the link between the institutional arrangement of the entities that direct public transport provision and the physical separation or integration between interchange components, and the link between design and planning guidelines and the quality of the user transfer experience at interchanges. The responses to the research questions throughout the previous chapters have made it possible to articulate recommendations on how public transport institutions and interchange design and planning guidelines should be adjusted in order to put the user first. The recommendations are structured according to these two themes.

6.3.1 The Role of Integrated Transport Authorities

This research project was inspired to a large extent by the high level of interest from South African transport practitioners and authorities in the so-called 'model' transport cities in South America, in particular Bogota, in Columbia, and Curitiba, in Brazil. These cities have managed to create relatively successful Bus Rapid Transit (BRT) solutions to their particular transport problems. Since it was not possible to document Bogota as part of this study, Sao Paulo was identified as an alternative site, since it has also introduced various bus-based transport solutions, but it has done so only since the 1990s. Sao Paulo also had a more integrated institutional structure, albeit not to the same level as in Curitiba.

The policy documents reviewed in this study indicate that it is the intention to provide similar systems in South Africa cities. The apparent success of BRT in South American cities is in large part ascribed to the presence of a unified transport provision authority, an

opinion that South African transport policy has taken to heart. However, this study did not come across critical analyses of the applicability of the South American transport systems to South African cities. What appeared to be missing was a methodical audit of the elements of such systems that motivated why they were selected as examples to local practice, and to test the stated link between integrated institutions and effective transport provision. Thus, this study developed a framework for such an audit.

The main measure that linked the level of institutional integration to the success of interchange provision was the quality of the transfer experience of all users between different services. Even though institutional structures, modes and interchange layouts may occur in any number of different configurations in different cities, the needs of the user tend to be constant: transfer should be efficient, comfortable and safe. Policy recognises these needs, and states that they should be prioritised (Chapter 3).

However, the findings of this dissertation contradict the commonly held opinion that integrated transport authorities necessarily lead to improved transport services, if the user experience during interchange is taken as the measure. Within the confines of interchanges, the findings of this study indicate that the user's experience of the physical environment during transfer was poor in all cities, regardless of the level of institutional integration. The full institutional integration in Curitiba, partial integration in Sao Paulo, or nominal integration in Cape Town, proved to be little indication of whether the user's transfer experience would be good or poor. Rather, the main effects of integration appeared to be that a common fare management strategy could be implemented, and that facilities could be made less land extensive, thus limiting travel distance during transfer. It seems that having a single transport authority, along with better-matched modes, as is the case in Curitiba, reduces the need to duplicate platforms and provide internal access control points, in turn making more efficient use of space and reducing the complexity of the transfer process, as illustrated in Figure 6.1 on the next page.

Thus, the first recommendation in view of the findings of this study is that the establishment of an overarching transport authority in isolation will not result in improved service to the user. This is not to say that this step should not be taken: the site investigations have indicated that institutional integration appears to be a prerequisite for the planning of more integrated public transport services, and consequently for the planning of more space-efficient and integrated interchanges. However, the other prerequisite for more effective user transfers has been shown to lie in the design of the interfaces between, and the physical and wayfinding characteristics of, the components of interchanges. These aspects are not addressed at the policy level, but at the level of the relevant design and planning guidelines, which are the subject of the next section.

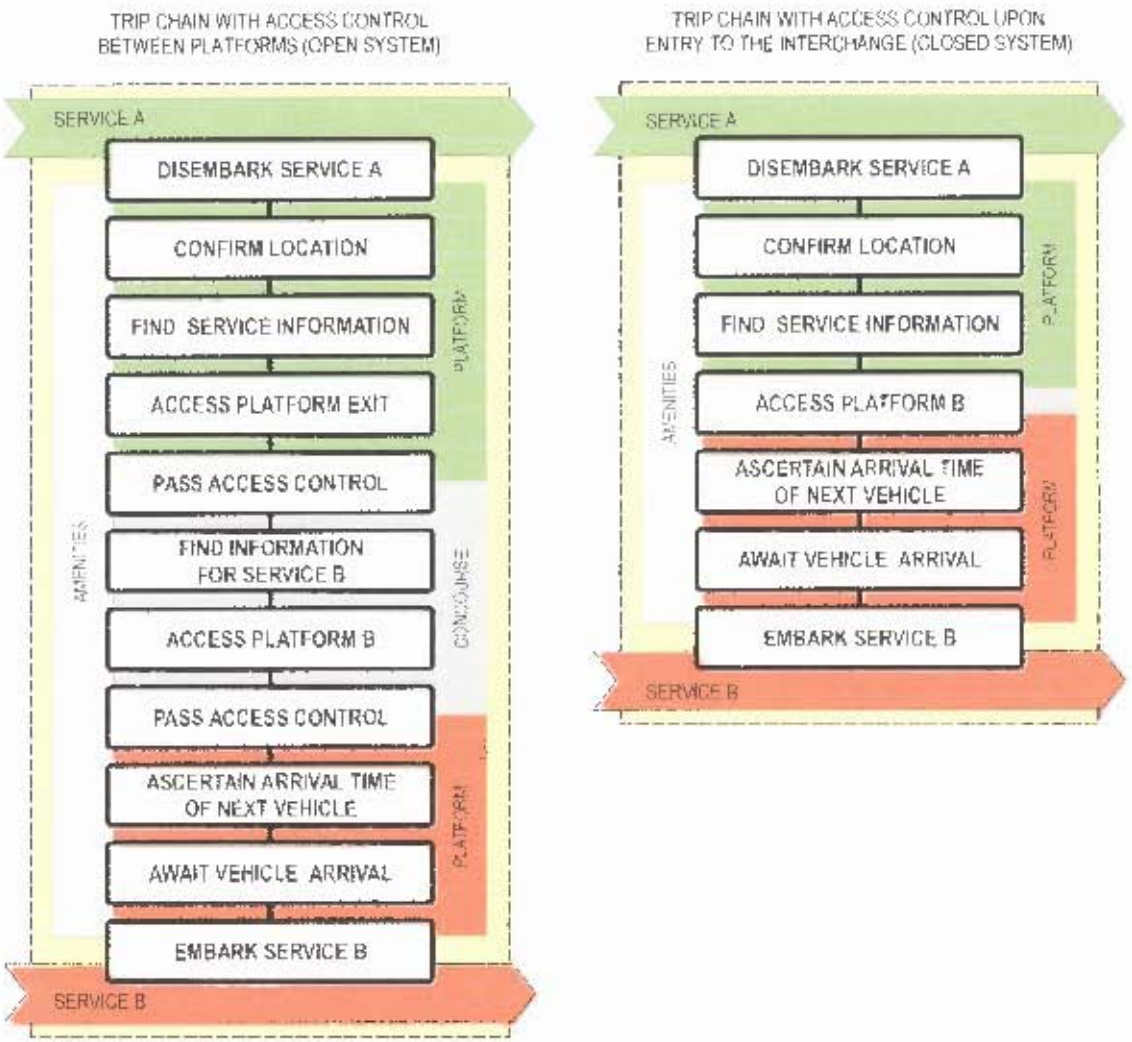


Figure 6.1: The effects of open versus closed interchange systems on user transfer

6.3.2 Revised Planning and Design Guidelines for Public Transport Interchanges

The previous section illustrated the limited extent to which integrated transport provision institutions can positively affect the user transfer experience at interchanges. As pointed out in that section, institutional integration only appeared to improve the user experience by enabling shorter and simpler transfer trips; it did not impact on the quality of those trips through improved accessibility or wayfinding. These aspects of the transfer trip are design issues, and should thus be addressed in the appropriate design and planning guidelines. However, in a review of the relevant guidelines for public transport facilities and interchanges in Chapter 3, it emerged that these documents do not provide a structured approach that ensures that the needs of all users during all tasks undertaken as part of the transfer trip chain are addressed. The oldest transport facility design guideline documents that were reviewed (RSA-DT 1985; RSA-DT 1990a) were developed to be mode and vehicle specific, only acknowledging the need to consider how users

transfer to other modes in the vicinity, but not providing more direction in this regard. Each subsequent guideline document was found to be based in large part on those mode-specific documents, adding certain improvement such as better provision for amenities or greater consideration of the urban context within which the facilities were or would be provided. Even the most recent guideline documents (GPG-DPTRW 2002, CCT 2005b) are still primarily based on those same mode- and vehicle-oriented documents. The application of the assessment framework developed in this dissertation confirmed that a vehicle-oriented design focus, as contained in these guidelines, ultimately translated into a poor quality transfer experience for users.

However, the assessment framework lends itself to applications beyond the boundaries of this dissertation. On the one hand, it is recommended that this framework should be applied in retrospect to interchange facilities that already exist and operate, as was done in this study, to test the quality of user transfers at such facilities and to provide insight into what obstacles should be removed to improve the transfer experience. Such an assessment of transfers would need to incorporate both qualitative and quantitative considerations. It is suggested that quantitative data on vehicle types beyond those currently specified in existing guidelines are required to assess vehicle circulation and holding requirements. In addition, data on volumes of vehicles and passengers arriving and departing on particular services, and transferring between their associated platforms, are necessary to assess walkway and queuing area capacities, and to optimise platform allocations to minimise aggregate transfer distances and crossing conflicts. In view of the findings of this dissertation, the attributes of user transfers that can be improved, without altering the physical layout of an existing interchange facility, are comprehensive wayfinding provision, integrated fare collection systems and accessible boarding features on vehicles.

On the other hand, the planned trunk and feeder networks in South African cities would likely lead to the construction of new interchange facilities, or the expansion of existing facilities to incorporate new services and vehicles. These interventions would provide excellent opportunities to improve the quality of user transfers and to prioritise users at interchanges from the outset. Not only would such improvements be desirable from the point of view of the user, but user prioritisation is also a requirement very clearly articulated by governmental policy. However, as illustrated in this dissertation, the interchange design and planning guidelines in use in South Africa do not adequately attend to the needs of users, nor do they provide a method for dealing with transfers between public transport services in a manner that assures an unbroken transfer trip chain for all users. Based on the findings of the Cape Town case studies presented earlier in this dissertation it seems as if the vehicle-oriented focus of interchange design and planning guidelines manifests itself in boarding area layouts that do not prevent, and can actually cause, conflict between vehicles and users. Not only would it be contrary to

the aims of public transport improvement plans to continue to infringe upon the personal safety and convenience of users in this manner, but it would also be an inexcusable missed opportunity if new or expanded interchanges do not redress the skewed balance between vehicle and user.

In order to address the problems of the current bias towards vehicle-oriented design, and the poor quality of user transfers at interchanges, there needs to be a fundamental shift in the interchange design and planning mindset. Since interchange planning and design guidelines are the on-the-ground arm of official policy, and as such direct the mindset behind the provision of interchanges, these guidelines must reflect a user-oriented approach. The guidelines must ensure, even before a pen is put to paper or a brick is laid, that all the parties involved in the provision of interchange facilities are clear on what a user-oriented approach to the design and planning of such facilities entails. The assessment framework presented in this dissertation provides the basis for such an approach, but does not, and cannot, claim to be a substitute for design and planning guidelines that prioritise the needs of the interchange user. Therefore, the final recommendation of this report is that new guidelines for the planning and design of interchanges have to be developed that take into account the findings of this dissertation. These guidelines should:

- Replace all previous mode-based guidelines with one overarching document that maximises the potential for integration provided by a unified transport authority – effective physical integration between road-based and rail-based services cannot take place if interchange provision is subject to fragmented guidelines;
- Contain strategies for the successful design, implementation and management of the components of interchanges involved in the user transfer process, and of the interfaces between these components; and
- Instil in officials and practitioners alike an understanding of what interchange is from the point of view of the user by describing in detail every step of the user transfer trip chain as well as the obstacles that prevent effective user transfers.

Besides supporting policy targets, these actions would enable a mindset shift towards a user-oriented approach in the planning and design of public transport interchanges.

6.3.3 Further Research

Due to the limitations necessarily imposed on this research project it was not possible to cover all the aspects of effective interchange provision in this study. In view of the need for revised, modally-integrated planning and design guidelines for public transport interchanges that was outlined in the previous section, a number of research tasks can be undertaken to assist in the development of such guidelines:

- During the literature review undertaken in this study very little data were encountered on user transfer volumes at interchanges. Two potential sources for such data were identified: the Current Public Transport Record of the City of Cape Town (2004-2005) and the National Household Transport Survey (RSA-DT 2003), but these proved to be not very informative on closer inspection. The former did not contain inter-mode transfer data, nor did it provide data on transfers between vehicles of the same mode at interchange facilities. In the latter, only 3328 persons were interviewed in the City of Cape Town, some of which used modes other than public transport. The small size of the sample, and the general focus of the Survey, did not allow for any conclusions to be drawn on the predominant types of transfers in the city or the magnitude thereof. There is definitely a need for more comprehensive data on transfer patterns in Cape Town to assist in determining the spatial allowances at interchanges for vehicles and users both actively or passively engaged in transfer activities.
- The task of developing new planning and design guidelines would be a considerable one. Seeing as this study found current guidelines lacking descriptions of, and input into, the actual process of user interchange, and that vehicular operations and spatial allocations appear to be very closely linked to the dimensions of existing vehicles, especially in the case of minibuses and overground rail, very little remains in existing guidelines that would not be subject to thorough review. This means that there is ample scope for engaging in research activities that would assist in the preparation of user-oriented guidelines for the planning and design of public transport facilities in general, and interchanges in particular. Examples of research activities would be the identification and analysis of user-oriented guidelines in developed and developing world contexts, and a compilation and testing of the operational and physical dimensions of current and upcoming public transport vehicles and technologies in the local setting.
- If transport services were to be restructured in accordance with the present policy aims, as outlined in this document, there would certainly be a need to redesign or retrofit existing interchanges and transport facilities to allow for efficient trunk-feeder interface, as motivated in the previous section of this chapter. This presents an opportunity to experiment, at both research and practical levels, with interchange planning and design alternatives aimed at improving user transfers at existing interchange sites in the form of pilot projects at these sites. The development of user-oriented guideline documents in conjunction with such pilot projects would enable the efficacy of the guidelines to be tested and refined before embarking on full-scale, capital intensive implementation. The authors of the guideline document for public transport facilities in Cape Town (CCT 2005b, reviewed in Chapter 3) followed a similar process. Even though the conclusion was that those guidelines did not exemplify a user-oriented approach, the value of the iterative process between pilot

project experimentation and guideline development is demonstrated in the real-world applicability of those guidelines. Thus, what is called for is a replication of the *process* contained in that document, but with a focus that prioritises the needs of the end user over those of the public transport vehicle.

TERMINOLOGY

For the purpose of accessibility, acronyms and words from references in the original Portuguese have been translated, wherever possible or desirable, into the nearest English equivalent by the author and verified with the aid of a bilingual dictionary (Collins 1998).

Furthermore, certain terms that are used throughout this dissertation could be interpreted in more than one way, or the reader might not be familiar with such terms. For the sake of clarity and consistency the meanings of such terms as they occur in the text of this dissertation are explained below.

Interchange

There are two distinct meanings of this term that are used in the dissertation, the one describing the facility, and the other the process that occurs at that facility. The first is an abbreviated form of 'public transport interchange' or 'transport interchange, that is, the term that describes the physical facility or space that forms part of the transport system at which passengers transfer between modes of transport (GPG-DPTRW: 6). The second meaning is the action of transferring between modes, or the process of interchange that occurs within the transport interchange. In this dissertation, interchange does not refer to the term that describes a freeway intersection in road design terminology

User

The user is any person who utilises the interchange with the purpose of gaining access to a mode of transport or transferring between modes. The user is thus also the person who performs the act of interchange, and the end user of the interchange facility. This term includes the meaning 'public transport passenger'. The interchange also accommodates persons who are not performing interchange, such as administrative and security personnel at the interchange, or traders selling their wares within the interchange. These persons are referred to according to such individual functions, and not as users.

Vehicle

The word vehicle is an abbreviation of 'public transport vehicle', or any vehicle that offers a public transport service. These vehicles transport users to and from the interchange and utilise the space provided for them at such a facility for the purpose of user interchange. Such vehicles are usually motorised, and include buses, train sets, minibuses, or any other mode of public transport that is present at the interchange.

Storage

At certain interchanges space is allocated to stationary public transport vehicles that are empty or awaiting the boarding of users. Such storage spaces have a similar function to general on-street parking in that the vehicle occupying such a space is not performing a transport function at that moment. In this dissertation such parking space for public transport vehicles is referred to as storage or vehicle storage, and should be distinguished from the drop-off and pick-up area at which users are boarding or alighting from a public transport vehicle

Non-motorised transport

Non-motorised transport is a term that described modes of transport that do not require a motor or engine. Walking, cycling and animal-drawn carts fall in this category. A person entering an interchange on foot and then boarding a bus to an onward destination is performing a transfer between a non-motorised mode and a public transport mode.

Transfer trip chain

The act of interchange encompasses a number of sequential tasks that the user has to perform. These actions, from the time of alighting from the mode of arrival to boarding the onward mode, describe a chain of actions that have to be completed for the user to successfully perform a transfer, or in other words a short trip between the modes. The number and nature of tasks that make up the trip chain vary according to the specific transfer being performed, and are described in greater detail in Chapter 4. Because the transfer trip chain describes the act of interchange, the space in which it occurs can be called an interchange, whether it is a formal or informal facility.

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